Microfilm Scanner 400/500

SERVICE MANUAL

REVISION 0

Canon

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Use of this manual should be strictly supervised to avoid disclosure of confidential information.

PREFACE

This service manual contains all the basic information required for after-service and maintenance of MS400/MS500.

Contents

Chapter 1: General Description
General feature, specification, names of each unit, and operation.

Chapter 2: Basic Description
Outline of image processing principles.

Chapter 3: Operation
Description of operating principles of electrical and mechanical systems, functions, and timing of operations.

Chapter 4: Mechanical System
Description of mechanical system, its disassembly, assembly and adjustment.

Chapter 5: Installation
Location and installation procedure.

Chapter 6: Maintenance and Servicing
Parts requiring periodic replacement and consumable parts.

Chapter 7: Troubleshooting
Troubleshooting and service modes.

Appendix: General Circuit Diagram etc.

Information contained in this manual is subject to change with improvements. Notification of changes will be given in Service Information Bulletin.

The information contained in the Service Manual and the Service Information Bulletin is necessary for proper maintenance of MS400/MS500.

Quality Assurance Center
Canon Electronics Inc.

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I. FEATURES

1. Efficient Operation

Operation has been simplified with motorized adjustment of the image on the screen, automatic switching of film polarity, and various intensified image editing functions when printing, and other features.

2. Compact Size

Thanks to the development of a new scanner, the machine has been made compact being 442mm wide, 541mm deep and 668mm high, and taking up only about 70% of the installation area required by MS100.

3. Computer Connectability

Due to SCSI interface, efficient use of document storage has been realized by incorporating microfilm images into a computer.

4. By Changing Carriers, Can Handle Various Film Types and Search Methods

The machine is able to answer to a variety of user needs by being able to take a wide range of carrier types from the roll/fiche carrier to the FS carrier.

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II. SPECIFICATIONS

A. Model

	MS400	MS500
Main body	Desktop	
Light source	Halogen lamp (20V 150W) with reflecter	
Image scanning	Photosensitive device (BASIS)	
Image output	400dpi	

B. Functions

	MS400	MS500
Print density	AE: N-P 0.8 - 1.2, P-P 0.2 max. Manual: N-P 0.6 - 1.4, P-P 0.3 max.	
Projection lens magnification	• Single lens: ×7 (common) • Zoom lens : ×9.5 - ×16, ×16 - ×32, ×30 - ×55 (common) • Zoom lens : ×20 - ×48 (MS500)	
Types of film used	Fiche / Jacket / AP card: FC190RII, RFC100 35 mm roll: AC100R 16 mm roll: AC100R, AC100M, AC100C, FS controller I, FS controller III, RFC100	
Film	Silver halayd, Diazo (black, blue-black)	
Screen	Transmissive type 300mm × 300mm (glare type)	
Print polarity	N-P, P-P	
Image density adjustment	• Manual adjustment (33 steps) • AE (w/slight adjustment)	
Lens replacement method	Replace with lens holder	Replace lens body tube
Image rotation	By prism rotation (0-360°)	
	Lever control (manual)	Dial control from control unit (electrical)

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	MS400	MS500
90° automatic rotation	—	Key operation from control panel
Focusing	Lever operation of lens mirror tube (manual)	Dial operation from control panel (motorized)
Zooming	Lever operation of lens mirror tube (manual)	Dial operation from control panel (motorized)
Light source	Halogen lamp (20V 150W) with mirror	
Screen brightness adjustment	Yes	
Uneven light intensity correction	Dial adjustment (6 steps)	Automatic correction
Scan width	• Sensor reading width: 220mm • Actual effective image width: 200mm	
Effective scan width	280mm	
Scan resolution	400 dpi × 400 dpi	
Gradations	256 steps	
Scan speed	Less than 7 seconds	
Continuous print copies setting	Max. 99 copies (with only 1 scan)	
Sharpness adjustment	User cannot adjust but changeable with service mode	User can adjust in 5 steps, also adjustable with service mode
Picture mode	No	Yes
Binarizing process	• When printer is connected: Error diffusion process • When PC is connected: Error diffusion process/simple binary selection	
Compression	• When printer is connected: No compression • When PC is connected: MR/MH/MMR/None selection	
Electronic magnification	No • When printer is connected and cassette for LGL is mounted, automatically magnifies to 128%	
Add-on function	• Date: Year, month, day, time • Message: 33 alphanumeric and symbol characters (when changed to LGL size, character size is also magnified)	
	Setting with service mode (Enable/unable selection with service mode)	Setting by user from control panel (Selection by user from control panel)
Automatic black frame erasure	• Mode 1: No frame • Mode 2: With frame	
Trimming	Available (designate with cursor by attaching option kit)	

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	MS400	MS500
Automatic rotation scan	No	Yes (designate from control panel)
Centering	No	No
Skew correction	No	No
Selection of film polarity	• Manual selection • automatic selection	
Reset function	No	Yes (returns to user set default)
Cassette selection	No	Yes (designate from control panel)
Location of control panel	Below screen	• Below screen • Separate type (keyboard)
Image data output I/F	• When printer is connected: Video I/F • When PC is connected: SCSI-2 (handles ASPI)	
Self-diagnosis	Yes	

C. Others

	MS400	MS500
Power supply	100-120V 50/60Hz 220V-240V 50/60Hz	
Weight	26kg	Main body: 27kg Keyboard: 0.8kg
Temperature range	10°C - 32.5°C (50 - 90.5°F)	
Humidity range	20% - 80% RH (relative humidity)	
Atmospheric pressure range	608 - 1013 hPa (460-760mmHg)	
Max. power consumption	290W	
Noise	During standby: Max. 55dB, during printing: Max. 66dB	
Dimensions	Main body only: 442 (W) × 668 (H) × 541 (D) mm With carrier: 516 (W) × 668 (H) × 541 (D) mm	

Specifications subject to change due to improvement of product, etc.

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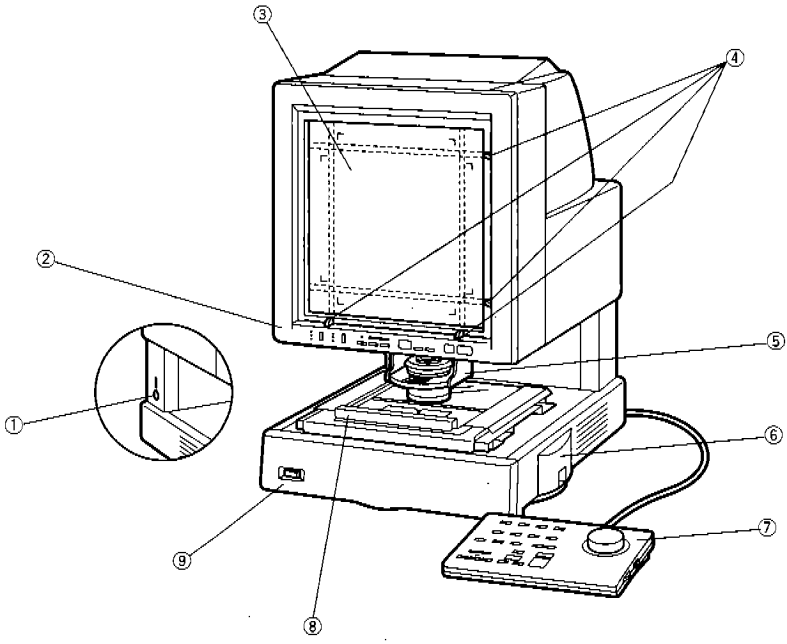
III. PARTS OF MS400/MS500

A. Appearance

1. Front view

- MS500



① DIN connector
② Control panel
③ Screen
④ Area designation cursor (option)
⑤ Lens holder
⑥ Illumination lamp unit
⑦ Keyboard
⑧ Carrier
⑨ Power switch

Figure 1-1

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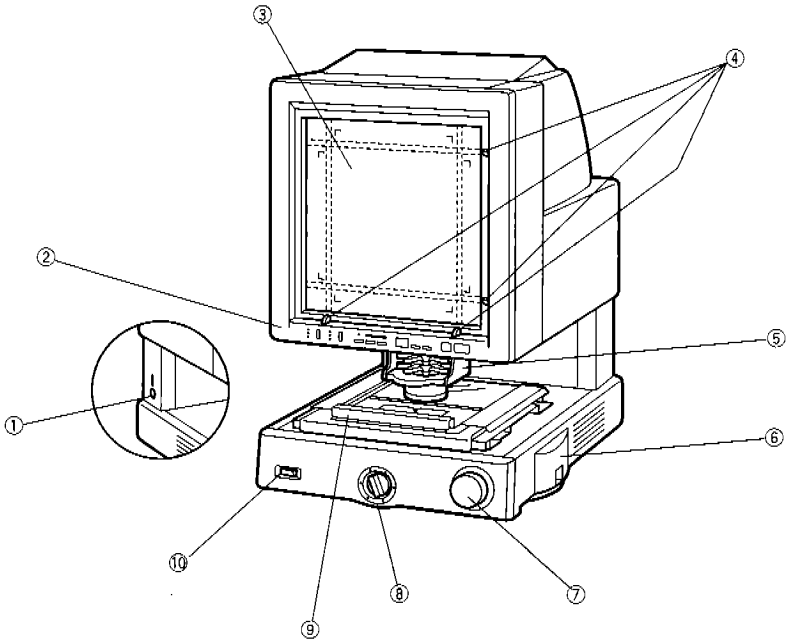
• MS400



① DIN connector
② Control panel
③ Screen
④ Area designation cursor (option)
⑤ Lens holder
⑥ Illumination lamp unit
⑦ Speed control knob (option)
⑧ Light intensity adjustment dial
⑨ Carrier
⑩ Power switch

Figure 1-2

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IV. DESCRIPTION OF OPERATION

A. Basic Operation

The followings are the basic operation of MS400/MS500:

1. Turning the power to peripheral devices ON
2. Turning the power MS400 or MS500 ON
3. Loading film to the film carrier
4. Setting the focus
5. Matching the screen image into the print frame
6. Setting the screen image to the right magnification
7. Selecting a proper image processing
8. Setting the number of prints
9. Pressing the print key
10. Confirming the screen image
11. Takeing out the film
12. Turning the power OFF

End

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B. Names of Displays/Keys

1. Control panel

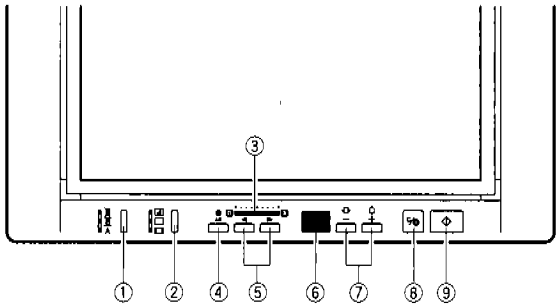

Figure 1-3

① Negative/Positive selector key
Selects automatic detection, negative film or positive film.

② Automatic border erasure key
Selects total frame erasure, frame border erasure, or trimming.

③ Print density indicator
Used for displaying the set print density and also for adjusting sharpness and setting date/message

④ AE key
Automatic adjustment of print density

⑤ Print density adjusting key
Used for adjusting the print density and also for adjusting sharpness and setting date/message

⑥ Print number indicator
Displays the number of prints, and error codes

⑦ Print number setting key
Sets the number of prints (+, −)

⑧ Clear/Stop key
Changes the number of prints or stops printing

⑨ Print start key
Executes printing

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2. Keyboard (MS500 only)

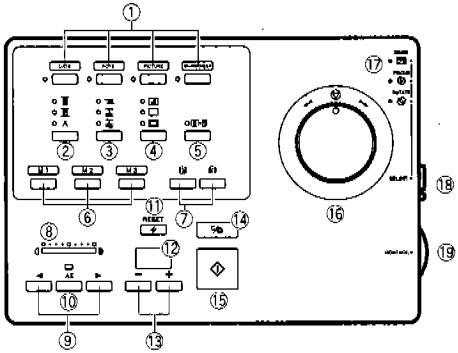

Figure 1-4

① Function key
- Date key
  Prints date when printing
- Note key
  Prints the set message
- Picture key
  Used when printing the halftone images
- Sharpness key
  Used when adjusting the print image

② Negative/Positive selector key
Selects automatic detection, negative film or positive film

③ Cassette selection key
Selects pick-up cassette of the printer (effective when FP300 is connected)

④ Automatic border erasure key
Selects total frame erasure, frame border erasure, or trimming

⑤ Automatic rotation print key
Rotates the image from horizontal position to vertical position, and prints

⑥ Zoom key
Used for automatically adjusting the set zoom magnification, and registering the zoom magnification

⑦ Rotation key
Rotates the image by 90 degrees

⑧ Print density indicator
Used for displaying the set print density and also for adjusting sharpness and setting date/message

⑨ Print density adjusting key
Used for adjusting the print density and also for adjusting sharpness and setting date/message

⑩ AE key
Automatic adjustment of print density

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⑪ Reset key
Used for returning the setting mode to the initial set value, and also for setting the initial set value
⑫ Print number indicator
Displays the number of prints, and error codes
⑬ Print number setting key
Sets the number of prints (+, –)
⑭ Clear/stop key
Changes the number of prints or stops printing
⑮ Print start key
Executes printing
⑯ Film control knob (option)
Feeds the film when the auto carrier is attached. Note, however, that this knob cannot be used when FS controller I or FS controller III is attached.
⑰ Image adjustment mode LED
Displays the current image adjustment mode
⑱ Image adjustment selector key
Selects zooming, focusing, and rotation
⑲ Image adjustment control dial
Adjusts the image

3. Setting the Light Intensity Adjustment Dial

[MS400 only]

Adjusts the light intensity by bringing the dial to the same color as that of the magnification of the lens to be used.

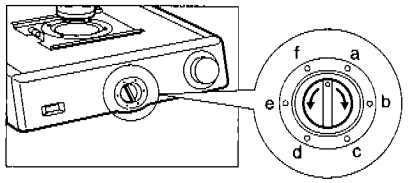

Figure 1-5

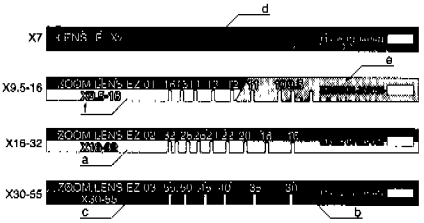

Figure 1-6 (Lens labels)

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4. When Using FS Controller I

When the carrier to be used is the FS controller I, do the following.

- In case of MS400

Take off the lower part of the lens and then use the lens.

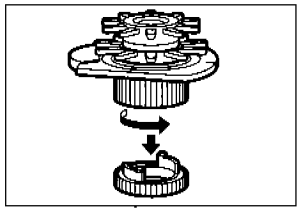

Figure 1-7

- In case of MS500

Take off the lower part of the lens and then reattach it in reverse.

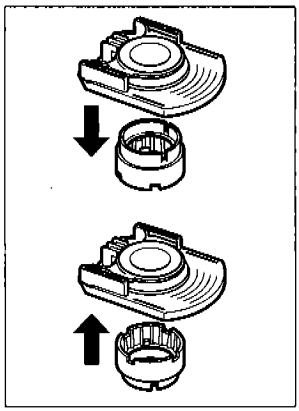

Figure 1-8

C. Power ON/OFF

1. When FS controller III is attached, first turn on the power to the FS controller III.
2. Turn on the power to the main body.
3. Turn on the power to the printer.
4. When the power is turned on, the machine will go into the warming up state.
   The machine can be used when warming up is over.

Note 1: In the case of MS400, the flashing of the number of print copies indicating LEDs denotes it is in the warming up state and when the indication changes to the lit state, it means the machine is ready for use.

Note 2: In the case of MS500, when the print start key on the operating keyboard is lit in red, it denotes that the machine is in the warming up state and when the red turns to green, it means the machine is ready for use.

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D. Setting of film

- Refer to the manual of the carrier to be used.

E. Adjusting of Image

[In the case of MS400]

a. Image focus adjustment
   Turn the focusing fin ③ attached to the lens.
b. Image zoom adjustment
   Turn the zooming fin ② attached to the lens.
c. Image rotation adjustment
   Turn the rotation fin ① of the main body.

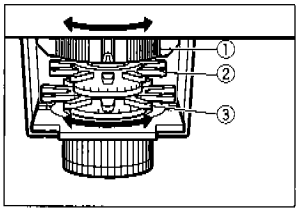

Figure 1-9

[In the case of MS500]

a. Image focusing
   1. Press the image adjustment selector key on the operating keyboard until the [FOCUS] LED lights, and set to focus mode.
   2. Turn the image adjusting control dial.

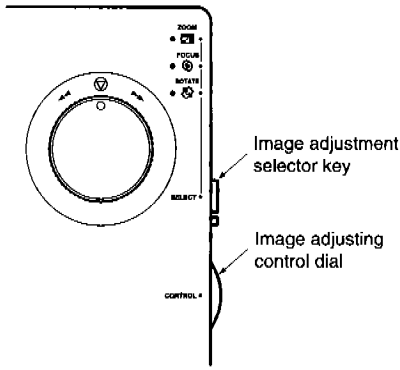

Figure 1-10

b. Image zooming
   1. Press the image adjustment selector key on the operating keyboard until the [ZOOM] LED lights, and set to rotation mode.
   2. Turn the image adjusting control dial.
c. Image rotating
① When rotating free degrees
   1. Press the image adjustment selector key on the operating keyboard until the [ROTATE] LED lights, and set to rotation mode.
   2. Turn the image adjusting control dial.
② When rotating 90°
   1. Press the rotation key on the operating keyboard.

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F. Printing

1. Printing Operation

a. Turn on the power to the main body and the printer.
Proceed with operation after the machine has finished warming up.
For details refer to the section on Power ON/OFF.

b. Press the negative/positive selector key and select the polarity of printing.
The setting changes each time the key is pressed, and the LED of the mode that has been set will light.

[In case of auto (A: automatic distinguishing)]
1) Automatically distinguishes the type of film and prints positive.
2) Type of film can be checked by the flashing of the negative or positive lamp when printing.

Note 1: The machine may not be able to distinguish the film type automatically when the black to white ratio inside the film frame is close to being equal or the image frame is small, and when area designation of the edge of the image is done using the trimming function. In such a case, select whether negative or positive.

c. Search for the image to be printed and display it on the screen.
Adjust the image so that it fits inside the print frame. For details, refer to the section on image adjustment.

d. Adjust the printing density.

[In case of automatic density adjustment]
1) When AE key is pressed, lamp lights and the image is automatically adjusted to the optimum density.
2) If density adjustment key is pressed, density can be fine-adjusted to a further 17 steps. The print density indicating lamp moves sideways indicating the fine-adjustment step.

[In case of manual density adjustment]
1) When the AE key lamp is out, density adjustment can be done manually.
2) Adjust by pressing the density adjustment key.
When the lamp moves to the right, density becomes darker and when it moves to the left, it becomes lighter.

e. Press the print number setting key and set the number of copies required.
When the plus key [+] is pressed, the number increases and when the minus key [-] is pressed, the number decreases.
If the clear/stop key is pressed, the number returns to 1.

f. Select the paper feed cassette
(Only MS500)
When FilePrint 300 (FP300) is connected, press the cassette selecting key and light up the required cassette.

Note 1: When the paper feed tray is selected, the set paper size is displayed for several seconds on the print number indicator.
At that time, check that it agrees with the paper size in the feed tray.
When it does not agree, error will occur when printing is carried out.

g. Set the various print modes as necessary.
For details, refer to the next section G.

h. Printing starts when the print start key is pressed.
- Press the clear/stop key to stop printing.

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G. Setting of Print Modes

- Set these before pressing the print start key.

1. Setting of Automatic border erasure

- Select by pressing the automatic border erasure key.

As the setting changes every time the key is pressed, light up the mode that is required.

a. ( ) Erases all the border around the image and prints.

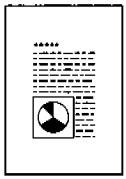

Figure 1-11

b. ( ) Puts a frame around the image, erases all other background, and prints.

Figure 1-12

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Note 1.
There are times when border erasure is not carried out when the frame of the image is not distinct.

Note 2.
Border erasure is carried out on the image inside the specified print frame.

Note 3.
When a number of images exist together on the screen, an untargeted image may be printed.

Note 4.
Border erasure is not carried out unless there is a non-image area of 5mm or more around the image.

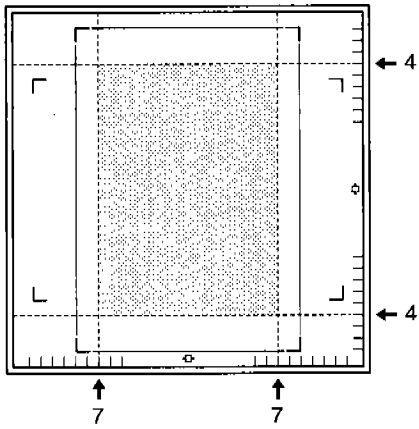

Figure 1-13

2. Trimming Function

a. When the area designation unit is not attached

1) Continue pressing the automatic border erasure key for about five seconds until the "Trimming" LED ( ) starts flashing.
The specified area is indicated on the number of print copies indicator.

2) Press the print number setting key and specify the area.
Input the numerical value of the indications shown at the right and bottom of the screen.

- Specify the area in the vertical direction with the [+]key.
Specify the area in the horizontal direction with the [–] key.
- The figure shows vertical direction: 4, and horizontal direction: 7.

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b. When the area designation unit is attached
Move the area designation cursors by using the knobs on the right and bottom of the screen.
The part surrounded by the four cursors will be printed.

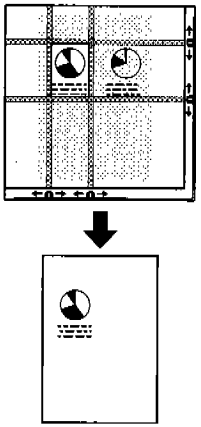

Figure 1-14

3. Automatic 90° Rotation Printing (MS500 only)

Automatically prints an image that is positioned sideways on the screen by rotating it 90° to the right.

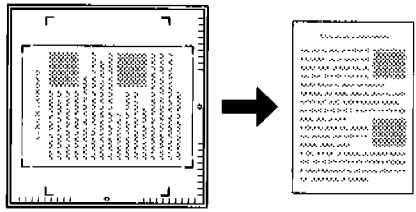

Figure 1-15

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H. Others

1. Setting the Date (MS500 only)

1) Continue pressing the date key for about five seconds. The date LED, the print density indicator, and the print number indicator will start flashing.

2) Check that the LED on the left end of the print density indicator is flashing, press the print number setting key, and set the [year] in the print number indicator.
[5 1] - [99]: 1951 - 1999
[00] - [50]: 2000 - 2050

3) Press [▶] of the print density adjusting key, and access the [month] setting mode. Press the print number setting key, and set the [month] in the print number indicator.
[0 1] - [12]: January - December

4) Press [▶] of the print density adjusting key, and access the [day] setting mode. Press the print number setting key, and set the [day] in the print number indicator.
[0 1] - [3 1]: 1st - 31st

5) Press [▶] of the print density adjusting key, and access the [hour] setting mode. Press the print number setting key, and set the [hour] in the print number indicator.
[00] - [24]: 0 hours - 24 hours

6) Press [▶] of the print density adjusting key, and access the [minute] setting mode. Press the print number setting key, and set the [minutes] in the print number indicator.
[00] - [60]: 0 minutes - 60 minutes

7) Press [▶] of the print density adjusting key, and access the [printing position] setting mode. Press the print number setting key, and set the [printing position] in the print number indicator.

Indication	Printing Position
	Upper left of paper
	Upper center of paper
	Upper right of paper
	Lower left of paper
	Lower center of paper
	Lower right of paper

Table 1-1

8) Press [▶] of the print density adjusting key, and access the [printing format] setting mode. Press the print number setting key, and set the [printing format] in the print number indicator.

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Indication	Format	Printed Examples
00	Year/month/day	1996/11/08
01	Year/month/day Hour:min	1996/11/08 21:15
02	Month/day/year	11/08/1996
03	Month/day/year Hour:min	11/08/1996 21:15
04	Day/month/year	08/11/1996
05	Day/month/year Hour:min	08/11/1996 21:15
06	Month/day/year	Nov 08 1996
07	Month/day/year Hour:min	Nov 08 1996 21:15
08	Day of week/month/day/year	Mon Nov 08 1996
09	Day of week/month/day/year Hour:minutes	Mon Nov 08 1996 21:15

Table1-2

9) When all the settings are finished, press the reset key. The settings are recorded, and the mode will return to normal.

2. Setting the paper size of the paper tray (MS500 only)

Press and hold down the cassette selection key for about 5 seconds until the LED for the paper tray starts blinking.

Then press the plus/minus key to set the correct paper size. (The size indicator is displayed on the print number indicator.)

Press the cassette select key to complete the setting.

The size indicators are shown below.

84: A4
11: Letter
55: B5
14: Legal

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3. Setting of Message Printing (MS500 only)

- Message can be recorded up to maximum of 33 characters.
- Message will be printed in the position set by date printing.

When printing the date, leaves one character space open after the date and prints.

1) Continue pressing the note key for about five seconds.
The message LED, the print density indicator and the print number indicator will start flashing.

2) Check that the LED on the left end of the print density indicator is flashing, press the print number setting key, and indicate the character code of the first character of the message on the print number indicator.
Example: When setting [A], display [4 1] on the print number indicator.

3) Press [▶] of the print density adjusting key and set the second character. In the same manner as step 2), set the character code in the print number indicator.

4) Continue in the same manner to record the required message.

5) When setting of the message is finished, press the reset key. The message is recorded and the mode returns to normal.
- How to look at print density indicator. Which character is being set at present can be checked by the flashing position of the print density indicator, while recording the message,.

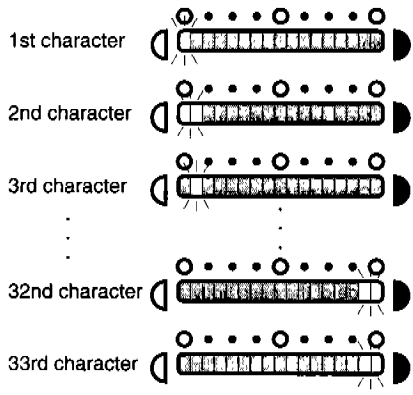

Figure 1-16

Code	20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F	Code 20 sets blank									
Character		!	"	#	$	%	&	'	(	)	*	+	,	−	.	/										
Code	30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F										
Character	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?										
Code	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58	59	5A
Character	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Code	60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F	70	71	72	73	74	75	76	77	78	79	7A
Character	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
Code	5B	5C	5D	5E	5F	7B	7C	7D	7E	7F																	
Character	[	\	]	^	—	{	|	}	~	⌂																	

Table 1-3

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B. Replacement of Illuminating Lamp

As the lamp and the metal parts of the illumination unit, immediately after the lamp has burnt out, are hot, do not touch them until they have cooled down to avoid being burnt. Leave the machine standing for a while without cutting off the power and do the work of replacing the lamp after checking that the lamp and metal parts have cooled down.

1. When the lamp has burnt out, leave it standing for a while without cutting off the power, and allow the lamp to cool.
2. Check that the lamp has cooled and turn off the power.
3. Hold the grip of the illumination unit on the right side of the main body and slowly pull the unit out.

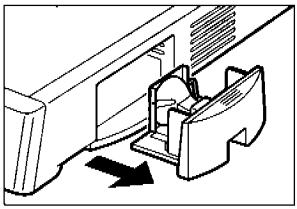

Figure 1-17

4. Raise the lever on the side of the lamp and take out the lamp that has burnt out.

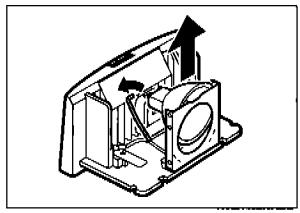

Figure 1-18

5. Install the new lamp so that the letters are on top and check that it has been properly inserted.

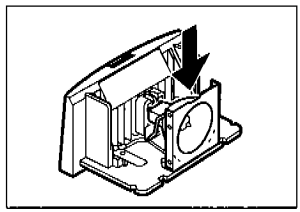

Figure 1-19

6. Insert the illumination unit into its orlginal place.

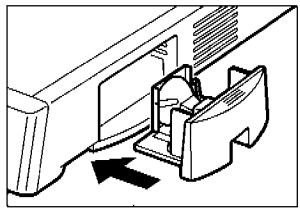

Figure 1-20

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V. REGULAR INSPECTION BY USERS

A. Cleaning

Clearly instruct the users to clean the following items at least once a week.

a. After wiping the carrier glass surface with a moist cloth, dry it with a dry cloth.
b. Clean the field lens with a blower brush.
c. Auto Carrier
   For refer to the service manual for each device.

B. Film

Carefully instruct the user on the following points concerning the film used or the film to be produced in the future.

(3M cartridge)
The cartridge should satisfy the values shown in Fig. 1-21, 22.

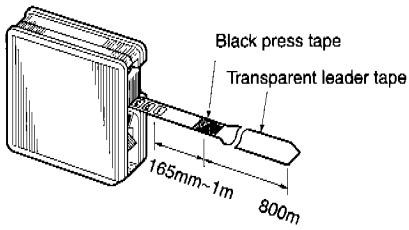

Figure 1-21

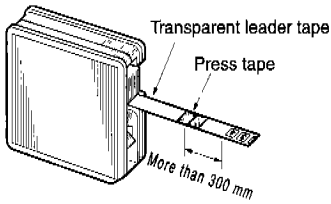

Figure 1-22

a. Leader tape should be 800 mm or greater and the trailer should be 300 mm or gretaer.
b. Black press tape should be used when the leader tape is spliced to the film.
c. Use leader tapes of 3M.
   Use a ransparent leader tape for the negative film and a black tape for the positive film.
d. Use a transparent press tape for the negative blip film, and a black press tape for the positive blip film, both of which should be 3M.

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(ANSI cartridge)
Leader

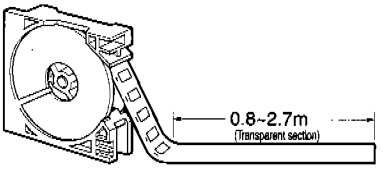

Figure 1-23

Trailer

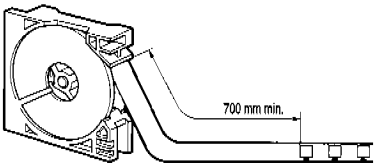

Figure 1-24

a. The leader should be between 0.8 - 2.7 mm and the trailer should be 700 mm min.
b. The leader and trailer should be transparent and not have any hazy areas.
c. The trailer holder should be used when the end of the film is placed in the cartridge reel.

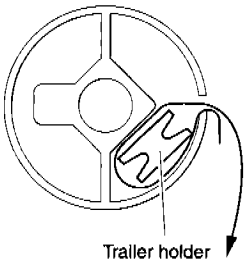

Figure 1-25

d. The leader should be cut at right angle.

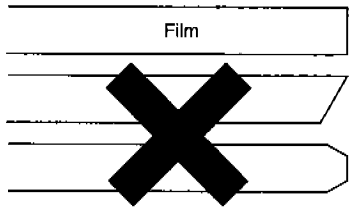

Figure 1-26

e. Use opaque when film is spliced to another length of film.

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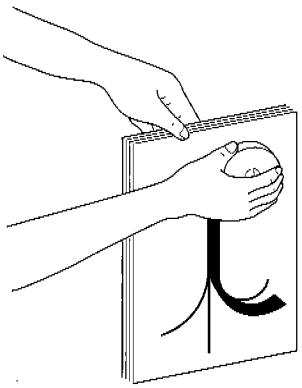
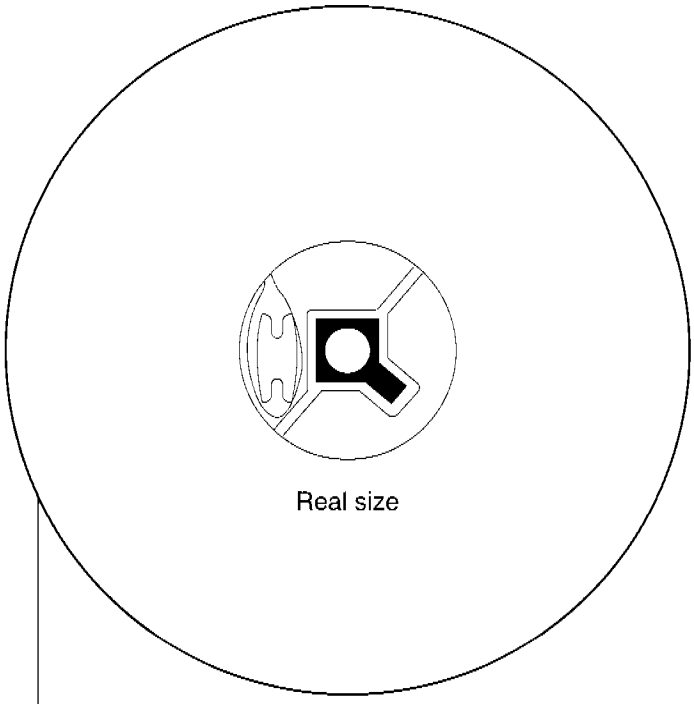
Film Curl (ANSI cartridge)
If the leader curl is too large, the film cannot be fed from the carrier supply.
Refer to the illumination below to confirm whether or not the film curl is with in the permissible range.
There should be no twisting, breakage, or damage from the top of the leader to within 50 cm of it.





Possible range for auto loading

Note: Force any film that is not in the range to within the permissible range.
With a pencil or similar item, press the curl in the opposite direction or connect the top of the film to a section of film that is within 5 mil of the permissible range.

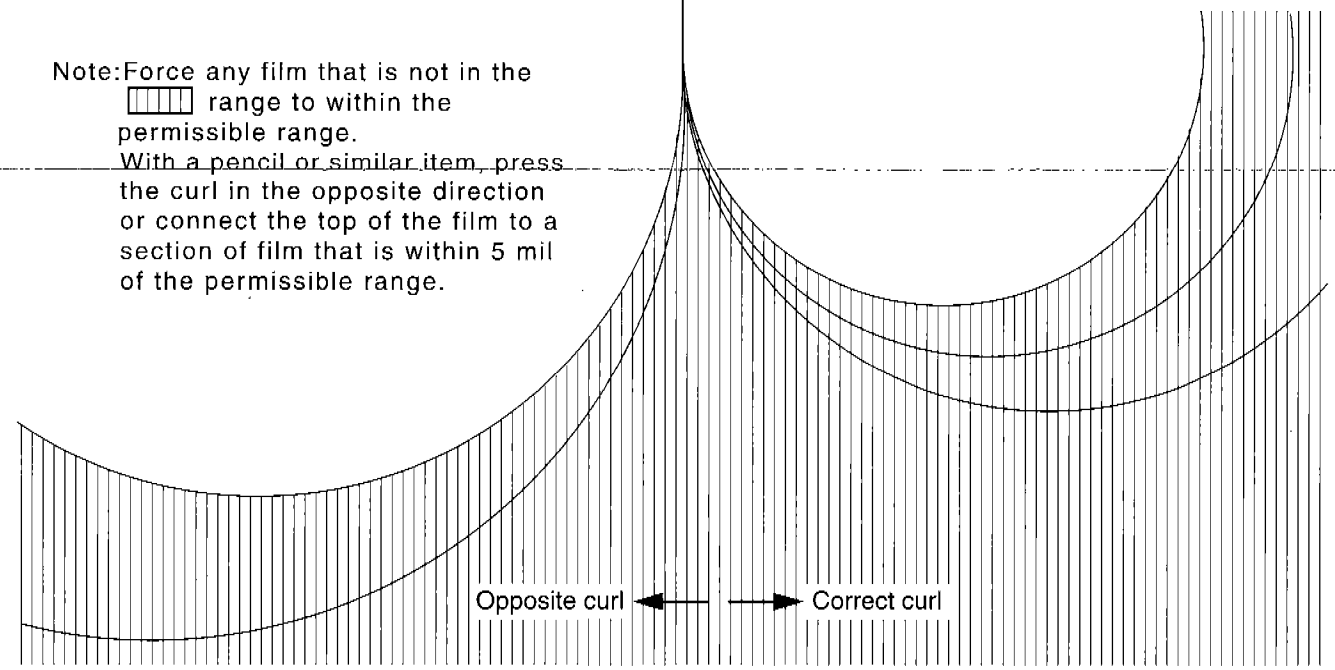


Figure 1-27

I. OUTLINE

1. Outline

Figure 2-1 shows configuration of the main part of the scanner.

The film is irradiated by the illumination lamp (halogen). This optical transmission is detected by a photosensitive device and converted to an electrical signal. (This is called photo-electric conversion.)

At this time the film image is picture-element-analyzed by the photo-electric device. After the electrical signals that correspond to the density of each picture element are processed in the image processor, the signals are then transmitted to the printer through the cable.

2. Photo-electric Conversion

The process of converting light into electricity, which is shown in Figure. 2-1, is called photo-electric conversion, and the device used for photo-electric conversion is called a "photo-electric conversion device".

The photo-electric conversion device used in this machine is a BASIS (Base Stored Image Sensor).

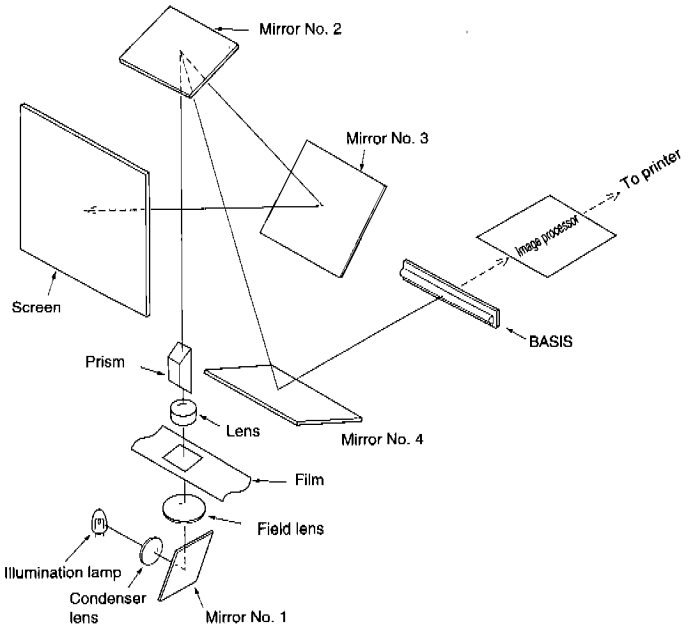


Fig. 2-1

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3. BASIS

BASIS causes several thousands of photosensitive devices of several tens of microns square in size to line up. BASIS is also a single chip photoelectric conversion device assembled with circuits that are equipped with a scanning function.

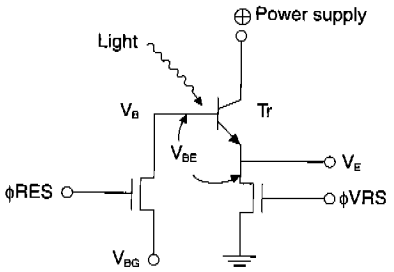

Fig. 2-2

Figure 2-2 is the equivalent circuit of one element (one picture element) of the BASIS photosensitive device.

BASIS timing is shown in Fig. 2-3.

BASIS internal operation is shown in Fig. 2-4.

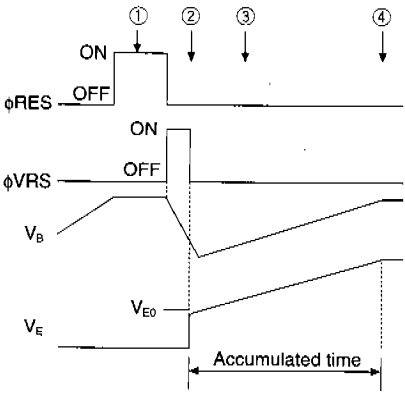

Fig. 2-3

Input the reset signal (H) to terminal ϕ RES and set the V_B terminal at the same electrical potential as V_{BG}. ①

After terminal ϕ RES goes low (L), terminal ϕ VRS goes high (H) and V_E is reset. After reset, if the i layer shown in Fig. 2-4 is irradiated with light, the i layer will transmit the light. Therefore, the p layer electrons are sent to the n1 layer and flow to the (+) power supply. The base voltage V_B gradually increases. ②

The amount of moved electrons is proportional to the light density.

If the n2 layer (emitter) electrons move toward the p layer, the emitter voltage V_E accumulates in the base capacity. ($V_E = V_B - V_{BE}$) ③

The emitter voltage V_E at the time when the predetermined accumulation time has elapsed is output. The voltage for the amount of the light irradiation becomes $V_E = V_{EO}$. ④

From the description above, the accumulated image information is read sequentially after amplified by each bits.

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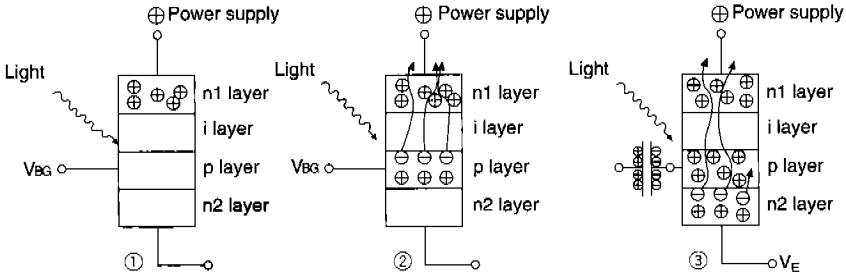

Fig. 2-4

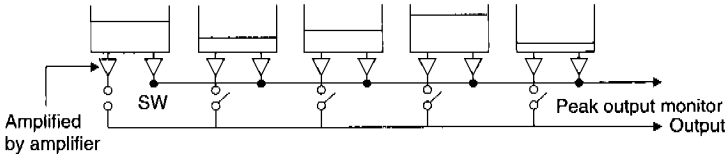

Fig. 2-5

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The voltage of each bit is output by opening and closing the switch (SW) in Fig. 2-5 independently. Depending on the open-close-open synchronous of this switch, the vertical scanning density is decided.

Normally, the opening and closing synchronous of the switch (SW) is electrically control in such a way that the vertical scanning line density is the same as the horizontal scanning line density (determined by the size of the photosensitive elements).

In this way, the image of the film is broken up into picture elements of several tens of microns square.

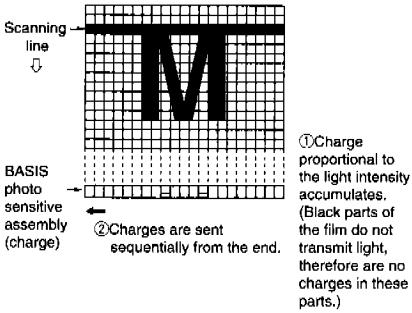

Scanning line
BASIS photo sensitive assembly (charge)
②Charges are sent sequentially from the end.
①Charge proportional to the light intensity accumulates. (Black parts of the film do not transmit light, therefore are no charges in these parts.)

Fig. 2-6

4. Picture Elements

During an actual scanning operation, a single scanning line is sub-divided into finer elements.

These elements constitute the building blocks of the image, therefore they are called "picture elements" (also "pixels" or "pels").

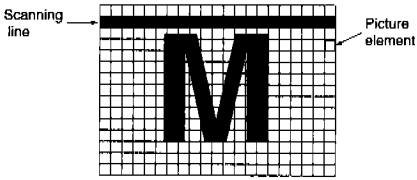
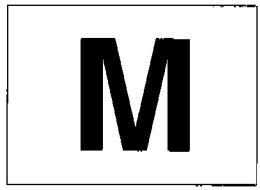


Fig. 2-7

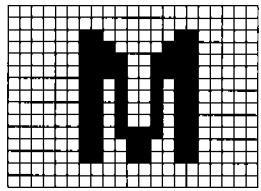
Each square shown in Fig. 2-7 is called a picture element.

The smaller a picture element, the more faithful will be the reproduction of the document image.



Image

Fig. 2-8



For larger picture element

Fig. 2-9

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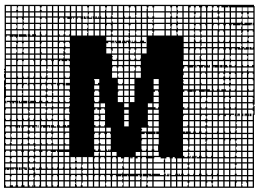

For smaller picture element

Fig. 2-10

From the foregoing, it can be seen that the smaller the picture elements are, the better the resolution is.

Resolution is expressed in scanning line density. The unit of resolution is dots/25.4 mm or raster line/25.4 mm.

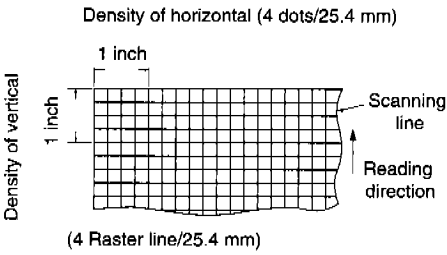

Fig. 2-11

Scanning line density
- Horizontal (=Main) scanning line density:
  This is the number of picture elements per inch along a scanning line in the horizontal scanning direction. (Unit: dpi)
- Vertical (=Sub) scanning line density:
  This is the number of picture elements per inch along a scanning line in the vertical scanning direction. (Unit: lpi)

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II. IMAGE PROCESSING

1. Image Processor

Figure 2-12 shows a block diagram of the main functions of the image processor.

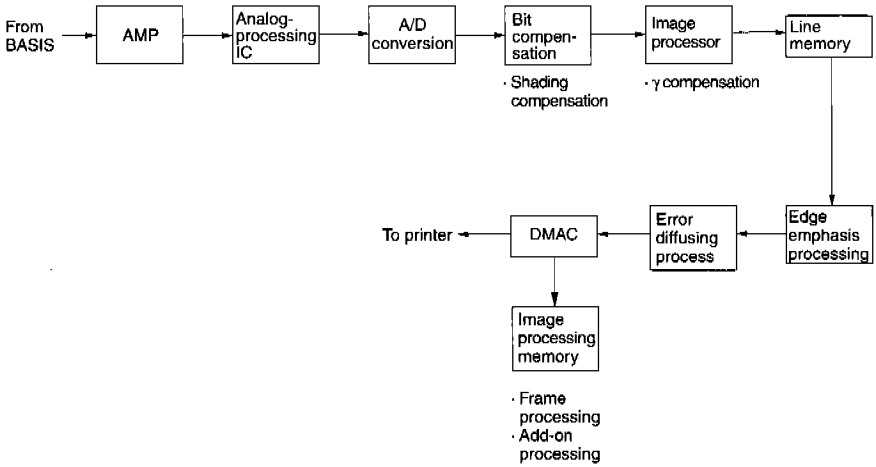

Fig. 2-12

• When recording (inputting) image

Electrical signals (analog values) proportional to the density of each picture element sent successively from the BASIS, after being amplified by the amplifier (AMP), are again amplified by the analog processor IC in proportion to the black level compensation and the sensitivity of each BASIS, and then converted by the A/D converter to digital signals (8-bit) corresponding to the density.

Bit compensation is then done in order to make the output of each BASIS bit uniform.

After that, the following multiple value image processing takes place at the image processor.

• Shading Compensation

Compensation is made for random variations in the light distribution of the illumination lamp and also for random variations in the sensitivity of each element of the BASIS.

• γ Compensation

Compensation matching the tonality of the film density is made. After processing by the image processor, the digital signals are binarized (density-processed) and at the same time edge emphasis processing and error diffusing process take place.

• Edge Emphasis processing

Emphasizes the outline of the image, when converting image signals to digital signals, in order to suppress the shading of the fine parts of the image.

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• Line Memory

Used to temporarily store the front line and back line of the horizontal scanning to carry out the edge emphasis process.

• Error Diffusing Process

Processing to recreate picture halftones.

The image signals that have undergone the above processes are temporarily memorized by image editing memory through DMA (Direct Memory Access).

Data stored in the image editing memory are subjected to image editing such as frame processing and add-on processing, etc. as necessary, and then output to the printer.

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2. A/D Conversion

As mentioned previously, the signals sent from the BASIS are analog signals, therefore they are converted into digital signals (to enable processing by a microprocessor).

Example:

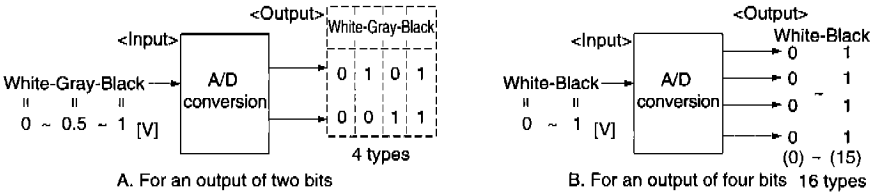

Fig. 2-13

Figure 2-13 shows the comparison between a case where the digital signal output after A/D conversion are two bit signals, and a case where they are four bit signals. (The input voltages differ from the actual values.)

If it were only necessary to evaluate whether the image density of the film was white or black, the output need only be one bit. In actual fact, however, it is necessary to reproduce halftones such as gray.

If the output is two bits, it is possible to output four values "00", "01",. "10", and "11" can be output.

Consequently, the input signal (analog) which changes from 0[V] to 1[V] as the image of the film changes progressively through white, gray, and black, is converted to a digital signal of one of these four levels corresponding to the specific analog level.

If the output is four bits, it is output sixteen values.

In other words, as the number of output bits increases, the resulting digital signal represents the changes in density of the film more faithfully (good tonality).

This machine uses eight bit signals to represent a total of 256 tonal gradations.

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3. Bit Compensation

When a fixed light intensity is distributed in the horizontal scanning direction, ideally all BASIS outputs should be equal. However, because the optical conversion efficiency for each BASIS bit is different, the outputs are not uniform.

This machine digitally compensates the outputs after the A/D conversion in order to make the outputs uniform.

$D_B(x) = D(x) \times 255 / \{B(x)\}$ ..... equation (1)

D(x): Image output data after A/D conversion

B(x): Output of the A/D conversion when the fixed light intensity is distributed.

$D_B(x)$: Image output data after bit compensation

From this compensation, a fixed image output can be obtained when the fixed light intensity is distributed as shown in Fig. 2-14.

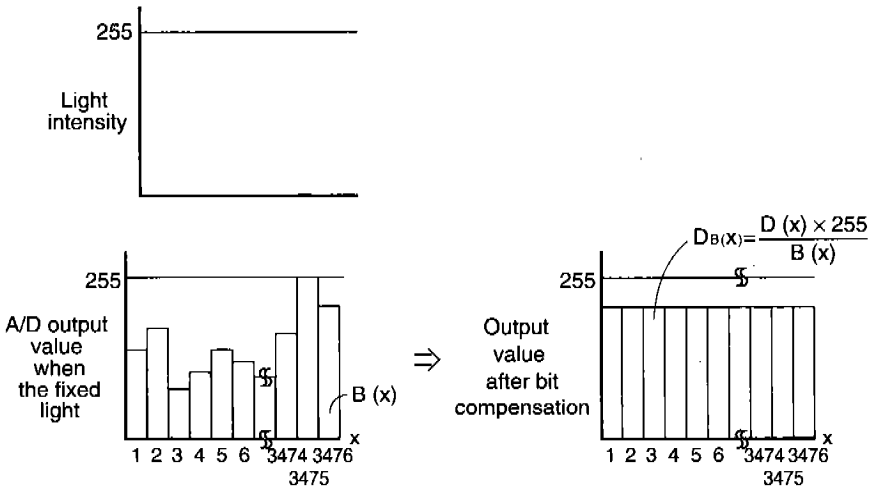

Fig. 2-14

4. Compensation for Shading

The BASIS output corresponding to each picture element is not necessarily a uniform, even if all the light reflected from a film of uniform density in the scanning line direction is detected. The reasons for this are as follows:

Reasons: 1. The light intensity of the illumination lamp is different to that at the periphery. Generally, the illumination lamp light intensity at the periphery is less than that at the center.
2. When there is an unevenly matched lens the intensity of the light passing through the center of the lens is different to that at the periphery of the lens.
3. Depending on the lens magnification, the transmission intensity differs.
4. Each of thousands of photosensitive devices in the BASIS differs in sensitivity.

Compensation for the previously mentioned variations in the output of the BASIS is called "compensation for shading".

In other words, when light transmitted off a film of uniform density is detected, the output at the ends of the BASIS will be different from the output at the center, hence compensation is applied by multiplying each BASIS output (corresponding to each picture element) so that the entire output is equal to the output at the center.

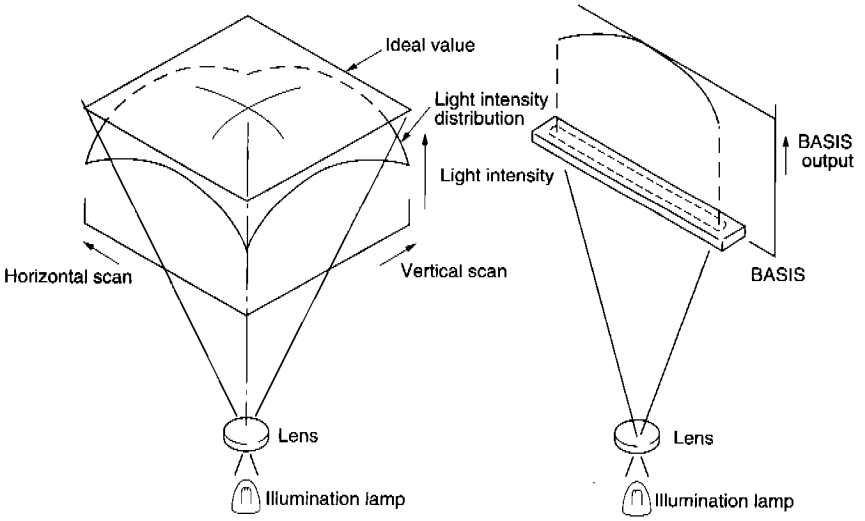

Fig. 2-15

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• Horizontal Scanning Direction Compensation For Shading

From the foregoing reasons, compensating for random variation of the BASIS output is compensation for shading of horizontal scanning direction.

At first imagine an arbitrary line of value M.

$$D_{BH}(x,M) = D_B(x,M) \times 255/\{H(x,M)\}$$

..... equation (2)

$D_{BH}(x,M)$: Data after horizontal scanning direction compensation for shading

DB (x,M): Output image data after A/D conversion

H(x,M): Output a data after bit compensation of line number M when there is no image. In other words, the horizontal scanning direction compensation for shading of line number M.

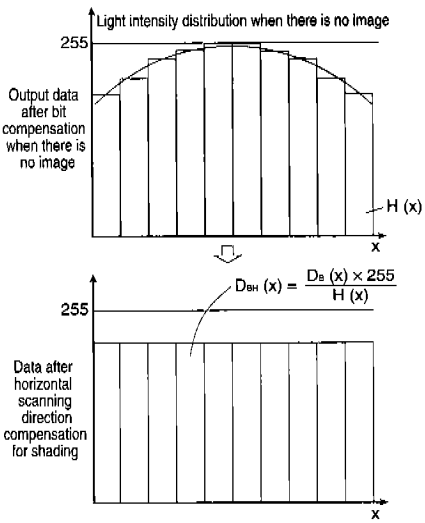
Light intensity distribution when there is no image
255
Output data after bit compensation when there is no image
H (x)
x
$D_{BH}(x) = \frac{D_B(x) \times 255}{H(x)}$
255
Data after horizontal scanning direction compensation for shading
x

Fig. 2-16

Next, if we imagine all the lines, H(x,M) exists for each line but, assuming that the light intensity distribution curve is the same for all the lines of this machine, the compensation for shading is performed using a standard compensation coefficient H(x) for all the lines.

$$D_{BH}(x,y) = D_B(x,y) \times 255/\{H(x)\}$$

Horizontal scanning direction compensation for shading value

..... equation 3

$D_{BH}(x,y)$: Data after horizontal scanning direction compensation for shading

H(x): Standard data after A/D conversion of all line with no image

$D_B(x,y)$: Image output data after A/D conversion

• Vertical Scanning Direction Compensation For Shading

Shading compensation in the horizontal scanning direction takes advantage of the BASIS output data compensation, but shading compensation in the vertical scanning direction changes the light intensity of the illumination lamp during scanning so that the light incident upon the BASIS becomes uniform.

The compensation data of this vertical scanning direction compensation for shading is handledas follows.

They are changed to pre-determined data corresponding to the magnificationof the lens used (location of condenser lens and field lens of illumination unit: 6 places). They are further changed to each of the indicated values (33 steps) of density.

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Method:

- The leading and trailing ends of the image is low in light intensity compared to the center of the image, and therefore the light intensity must be increased in accordance with the scanning timing.
- For instance, if a x16-32 zoom lens is used and set at x16, the light intensity tends to be low. This requires the light intensity to be totally increased. Conversely, if a high magnification lens is used, the light intensity is decreased.

5. Line Memory

The line memory is used to memorize one scanning line of data. The shading-compensated data (signal) is temporarily store in this memory.

Data cannot be read from memory during a "write" process timing, a two-line memory is provided, and "read" and "write" are executed in rotation. Data is written in one line of memory while data is read from the other memory.

This line memory is primarily used to compare the image density with the preceding line when egde emphasis processing is performed.

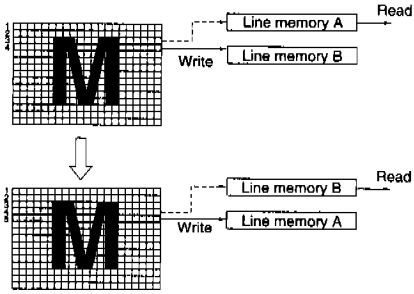

Fig. 2-17

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6. Tonal Compensation (γ : gamma compensation)

Ideally the image from the printer should be recreated on the film with the tone of the image of the original copy. However, the tone will change by the main causes shown below.

- Tone of the film
- Tone changes during film development
- Tone of the BASIS
- Tone of the printer (LBP)

This machine will output an image that has had its tone changed by the above cause, one picture element at a time in accordance with the specifications for image data labels. This procedure is called tonal compensation (γ compensation).

Figure 2-18 shows the relationship of the image data I/O by the tonal compensation process.

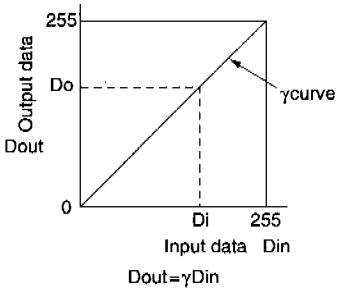

Fig. 2-18

When image data is read from the microfilm, depending on the film density and film types (silver halide, diazo), the contrast is greatly affected. Therefore, changing the compensation of the γ curve in proportion to the film contrast is necessary.

Figure 2-19 shows the same output data obtained from the change in the γ curve for negative film with or without contrast.

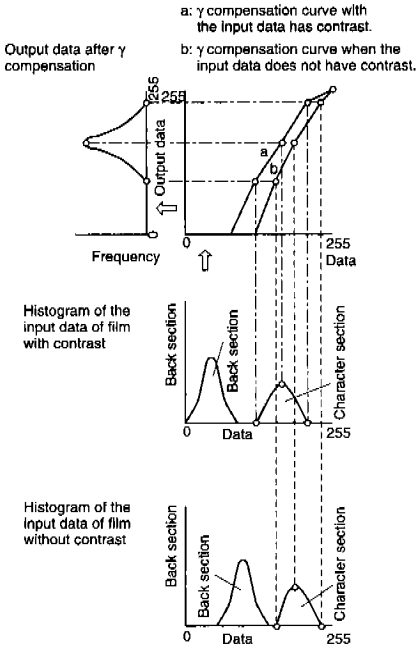

Fig. 2-19

When the picture mode is selected, γ =1.
In other words,
Dout = Din
so γ compensation is not performed.

7. Density Adjustment

The density adjustment of this machine determines the image output density by selecting the halogen lamp light intensity adjustment and γ compensation curve.

Density adjustment for negative film is explained below.

For negative film, generally speaking, the base density is either thick (high) with the contrast also becoming high or thin (low) with the contrast becoming low. Therefore, by performing the adjustment shown below an optimum image can be obtained.

Base density high
- Halogen lamp light intensity increases
- γ compensation curve goes down

Base density low
- Halogen lamp light intensity decreases
- γ compensation curve rises

Refer to Fig. 2-19.

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8. Edge Emphasis Processing

Edge emphasis is an electrical process that emphasizes light and shade make the image appear sharp. Figure 2-20 shows the waveform of the image signal obtained after edge emphasis.

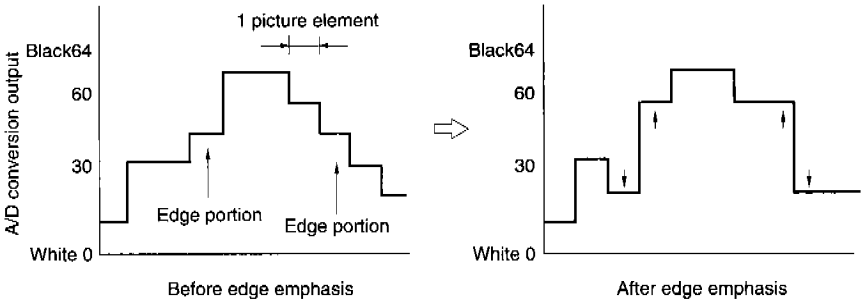

Fig. 2-20

Principle:

In density processing the data in the conversion table provided for edge emphasis is compared with the Target picture element.

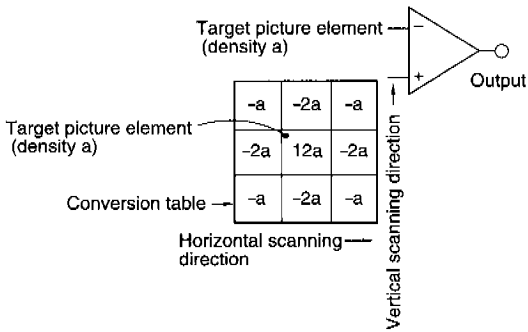

Fig. 2-21

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Example:

If the density of the target picture element is increased twelvefold and the density at four other picture elements is multiplied by -2 and four remained is multiplied by -1, the overall density will remain unchanged.

Arithmetic processing in the horizontal scanning direction is done simultaneously with data reading. Arithmetic processing in the vertical scanning direction is done by using the line memory to convert data in the previous line.

Figure 2-22 shows the principle of edge emphasis processing for the as where the compensated shading data consists of two bits.

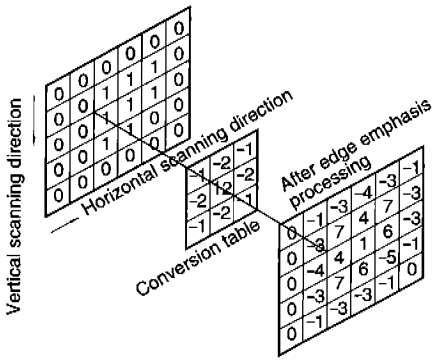

Fig. 2-22

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9. Slice Level Processing

As stated previously, when picture elements are seen in units of each picture element, they can only be expressed as either "black" or "white".

In order to separate one picture element into either black or white, a certain demarcation level must be set in the signals corresponding to the image density of the film and those higher than that level judged as "black" and those lower, as "white". (This is called binarizing)

Information: The level dividing a picture element into white or black is called the "slice level" (threshold value).

Slice level is normally compared with the values of the digital signals after shading compensation.

For example, when the BASIS output is converted into 4-bit digital signals with the A/D converter, the slice level is set at one of the values between "0" to "15" and compared to the output after shading compensation (likewise a value from "0" = "0000" to "15" = "1111").

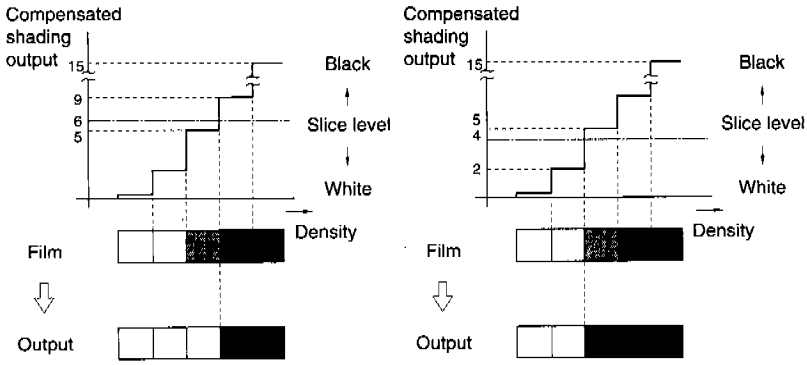

Fig. 2-23

Figure 2-24 shows an example when the digital signal ouput after A/D conversion is 4 bits and the slice level is "6." (This machine works with 8 bits.)

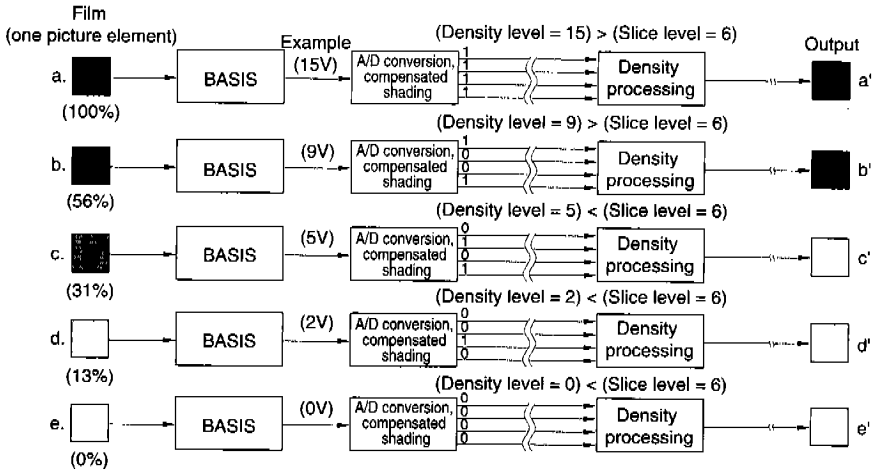

Fig. 2-24

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10. Error Diffusing Process

Error diffusing process is defined as the value of one picture element (four bits: darker = "0", lighter = "15". This machine works with 8 bits, and therefore they become 0 and 255, respectively.) which is compared to a datum threshold value. When the comparison result is smaller than the threshold value, the output is output as a "0". If the result is larger, the outputs is "15".

The difference between the input picture element value and the output picture element value is then added to the picture element that is processed next. The result of the picture element value that was added is processed in order in the next process as an input picture element value. This result, the value of the easily binarized input picture element and the value of the advantage density of the total image processed by modifier error diffuse, is about the same.

A detailed example is shown next. The density slice level is processed as an "8". Firstly, when line 1, column 1 is processed, since density (3) is smaller than slice level "8", with a "0" output density, the error generated there is "+3" (=3-0). (Fig. 2-25)

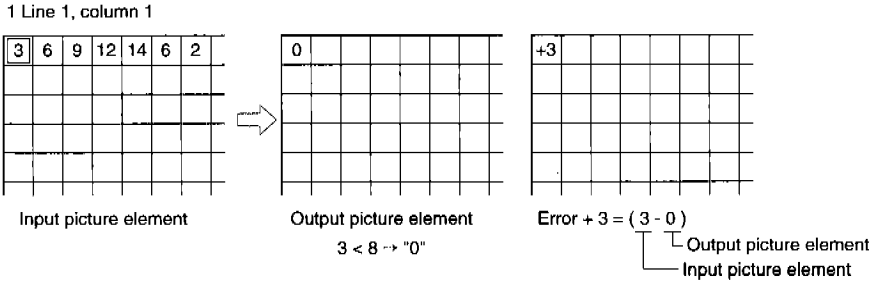
1 Line 1, column 1
3 6 9 12 14 6 2
0
+3
Input picture element
Output picture element
3 < 8 → "0"
Error + 3 = (3 - 0)
Output picture element
Input picture element

Fig. 2-25

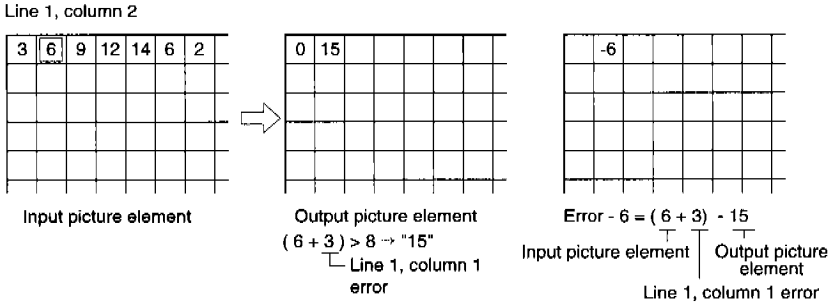
Line 1, column 2
3 6 9 12 14 6 2
0 15
-6
Input picture element
Output picture element
(6 + 3) > 8 → "15"
Line 1, column 1 error
Error - 6 = (6 + 3) - 15
Input picture element
Output picture element
Line 1, column 1 error

Fig. 2-26

When line 1, column 2 is processed, since the error is diffused in the right direction, the density of the line 1, column 2 picture element becomes "9" (=3+6).

Because this value is lager than the slice level, the output density becomes "15" and the error becomes "-6" {=(6+3)-15}. (Fig. 2-26)

The density of the line 1, column 3 picture element is "3" (=9-6). Since this is smaller than slice level "8", the output density becomes "0" and the error becomes "+3" {=(9-6)-0}. (Fig. 2-27)

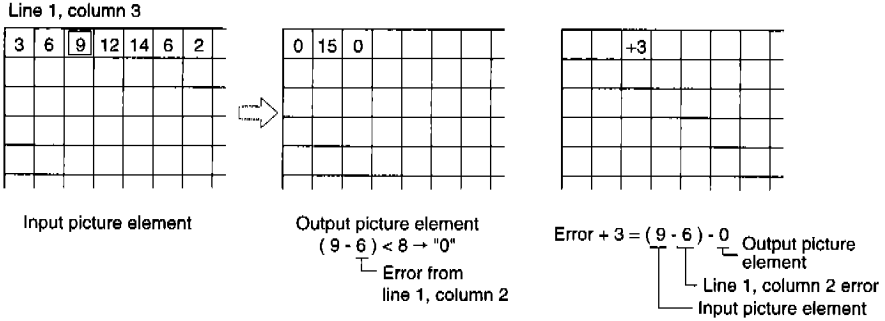
Line 1, column 3
3 6 9 12 14 6 2
0 15 0
+3
Input picture element
Output picture element
(9 - 6) < 8 → "0"
Error from
line 1, column 2
Error + 3 = (9 - 6) - 0
Output picture element
Line 1, column 2 error
Input picture element

Fig. 2-27

In the same way as above the following process is performed. (Fig. 2-28)

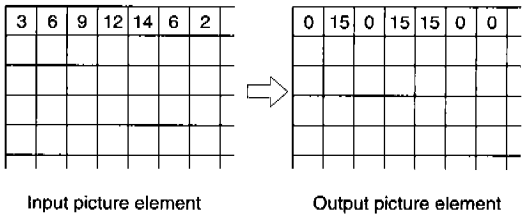

Fig. 2-28

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For line 2, the density of line 2, column 1 is used as the datum for the processing. In the same way as above the following process is performed. (Fig. 2-29)

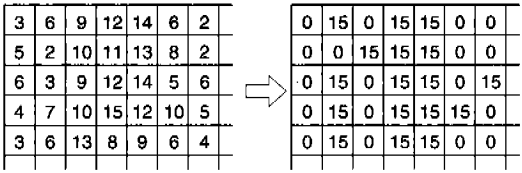

Fig. 2-29

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11. AE Processing

a. Outline

The AE processing is an automatic density conversion process in which the machine automatically measures the image density to enable printing with the best density.

This machine evaluates the image density condition by measuring the level of the fonal compensated image signal. Subsequently the slice level I/O conversion characteristics (density conversion curve) are changed and AE processing is done.

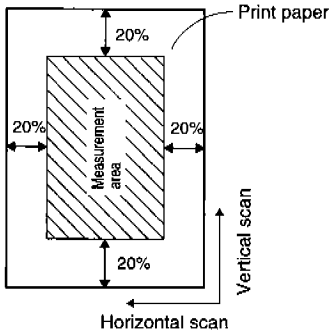

Fig. 2-30

b. Method

For AE processing, the optical system must be moved before the image scan, for measuring the image density within the designated area.

This is called pre-scanning.

During this pre-scanning the center (area shown in Fig. 2-30) of the area density that is equivalent to the print paper is measured.

Calculation methods for sampling during an actual measurement and the best density are explained later.

The outline of AE processing is shown in Fig. 2-31.

During the scan in order to collect the film data density under the same conditions all the time, in the illumination lamp intensity adjustment assembly the light intensity is made even.

The voltage applied to the lamp is changed so that the light intensity becomes constant in accordance with the lens magnification (or the position of the light intensity adjust dial) ..... ①

Pre-scanning is done with the light intensity that has been mode uniform (AE photometry) and then is read by BASIS. The analog signal is converted to an eight bit digital signal. ..... ②

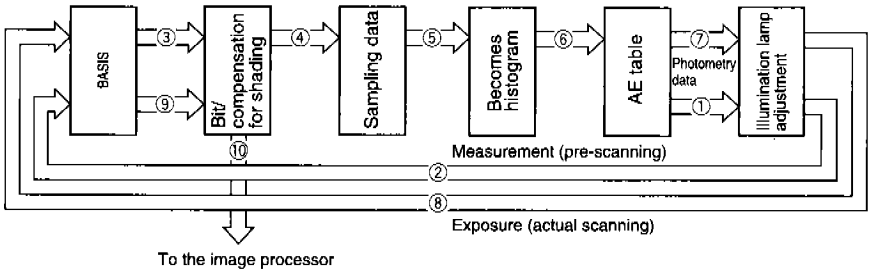

Fig. 2-31

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The eight bit data is subjected to shading compensation execute the BASIS sensitivity compensation and the uneven light intensity compensation. .....③

Data is sampled in the area shown in Fig. 2-30.

To eliminate data that differs from image data such as frames, all the data is not taken in the sampling data. ..... ④

Create a histogram with the data taken in. .....⑤

Based on the histogram data, the data is converted to eight bit exposure data and then output according to the AE table.

The AE table comes in two types: Negative and Positive. ..... ⑥

The illumination lamp light intensity for the print is decided from the eight bit exposure data in the AE table. ..... ⑥, ⑦

After compensation for shading once again, the data scanned by BASIS is sent to the image processor. .....⑧, ⑨, ⑩

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c. Sampling Method

The sampling method during AE photometry is shown in Fig. 2-32.

One data is sampled for one horizontal scan line.

The horizontal scan has eight picture elements and the vertical scan has one lines from the edge of the AE measurement area. In other words, the average value of eight picture elements is regarded as one piece of sampling data.

The average value of eight picture elements is regarded as sampling data to reduce the influence of data other than an image data such as dirt or dust.

The amplifier gain is switched to ×1 and ×5 for each line. To enlarge the dynamic range of the density data.

For the next sampling the data is sampled the with a gain of ×5 (five times) the same as before from the position shifted one vertical scan line from there.

In this way ×1 and ×5 gain data are sampled alternately.

After the sampling position reaches the end of the AE measurement area, the next data is sampled again from the top of the AE measurement area.

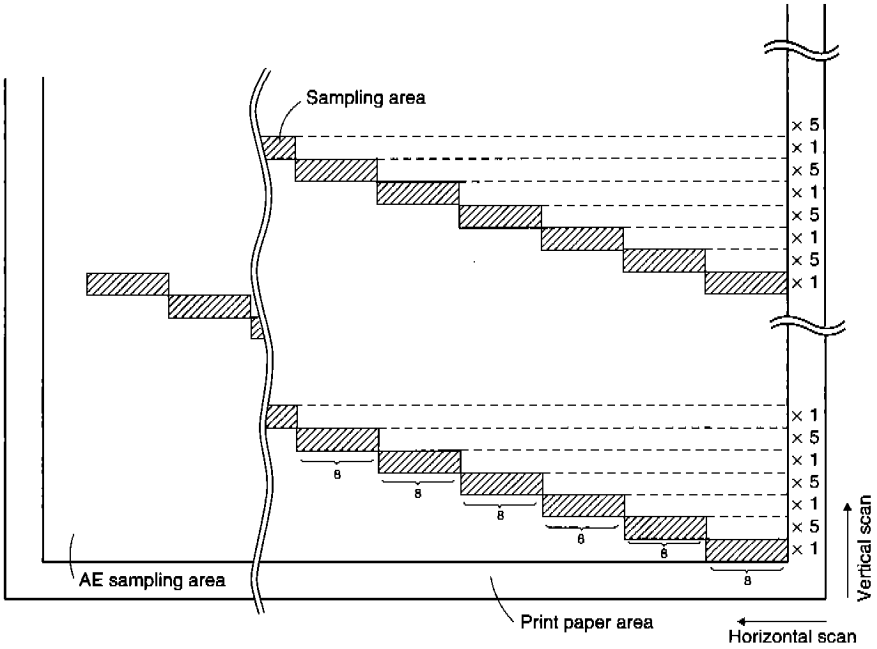

Fig. 2-32

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The AE measurement area is used as shown below for the trimming.

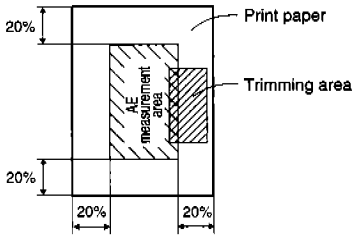


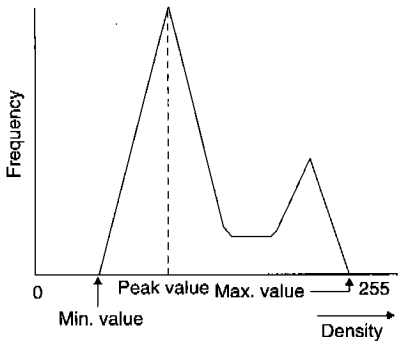
Fig. 2-33 For trimming

The trimming area is the same as the normal AE measurement area. (Not related to trimming position.)

d. Creating Histogram

The sampled data (for A4 size there are about 2800 pieces of data) is made into two different types (×1 and ×5) of histogram as shown in Fig. 2-34.

When a histogram is made, taking the effect of the dirt and dust into consideration, frequency ones data is ignored.



Min. value : With darkest density data
Max. value : With lightest density data
Peak value : With highest frequency data

Fig. 2-34 Histogram

In the two histograms, the Min. value is a parameter for Negative film and the Max. value is a parameter for positive film.

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12. Automatic Image Polarity Detection

Automatic image polarity detection is a function that automatically distinguishes negative and positive film without designating either.

The automatic image polarity detection is done by detecting the image density of the film.

Negative/positive polarity detection is done based on the histogram data of AE processing.

Figure 2-35 shows a typical histogram for negative and positive film.

When the peak value of density is at a position lower than 3/5 of the density level (darker overall), it is evaluated as a negative film. When the peak value of the density is at a position higher than 3/5 of the density level (lighter overall), it is evaluated as a positive film.

Therefore, for an image that has no character information such as a picture, there are chances of evaluating the data incorrectly.

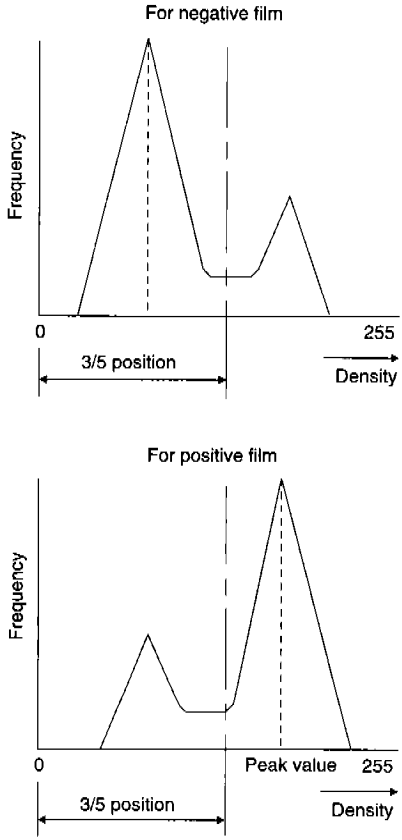

Fig. 2-35

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13. Variable Magnification processing

a. Outline

The variable magnification process of the machine consists of only a magnifying function - it has no reducing function. (Only when an LGL cassette is mounted on the printer does it print with a magnification of 128%).

b. Horizontal Reproduction Ratio (Main Scanning Direction)

The main scanning direction, after edge emphasis processing, reads the read clock at double speed (magnifies to double size), writes the image data into memory, and when reading from the memory carries out magnification change by skipping (thinning out) data.

c. Vertical Reproduction Ratio (Sub-scanning Direction)

The sub-scanning direction is thinned out after magnification change has been carried out on the main scanning direction.

14. Negative/Positive Inversion

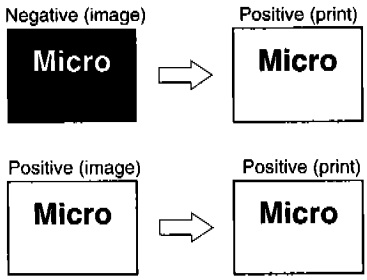
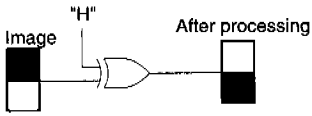


Fig. 2-36

By inverting the binarized "1" and "0" signals sent from the image processor, it is possible to get a print inverted from translucent (black) to transparent (white). (Negative → positive)

Positive → positive is not inverted. (No processing)

Inversion (Negative→positive)



Positive→positive is not inverted. (No processing)

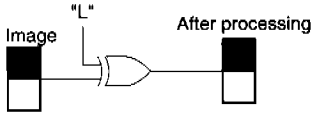


Fig. 2-37

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15. Trimming

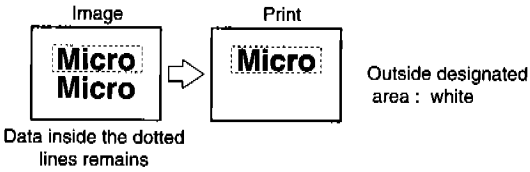

Fig. 2-38

Each picture element signal outside the designated area is forced to a white signal. (Not related to image signal)

■ Designated area

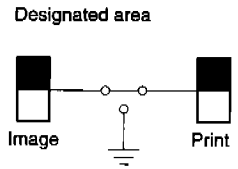

Fig. 2-39

■ Outside designated area

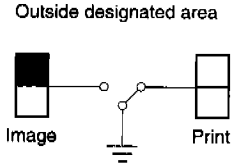

Fig. 2-40

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16. Black Frame Detection

a. Outline

By processing the image data sensed with BASIS, the image area is judged by the CPU on the DC controller PCB and frame erasure is carried out.

In automatic black frame erasure there are two modes, mode 1 which prints the detected image and mode 2 which puts a frame around the detected image and prints it.

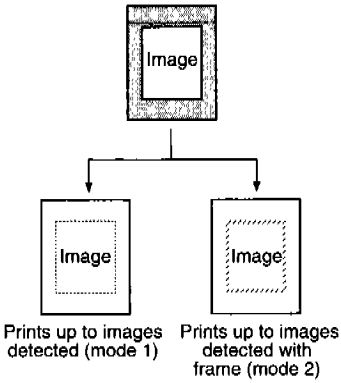

Fig. 2-41

b. Black frame detection

The machine processes a judgement block as a 4mm × 4mm square (64 × 64 dots), averages out the total picture elements of the block, and stores them in memory as 8-bit data (256 tones).

The machine then calculates if the density of the data of the judgement block is higher or lower than the prescribed value (slice level). For example, if the density is lower than the prescribed value, the judgement block is judged as "white" (transparent part).

In this manner, the judgement blocks are moved in succession to the position of the basic block (main scan 64 bits × sub-scan 64 bits) and judged.

One line each of the data processed in this way are processed in basic block units in the main scanning direction, and the density of each point is converted into binarized codes ("1", "0"). By doing this, the signals of the frame part can be detected.

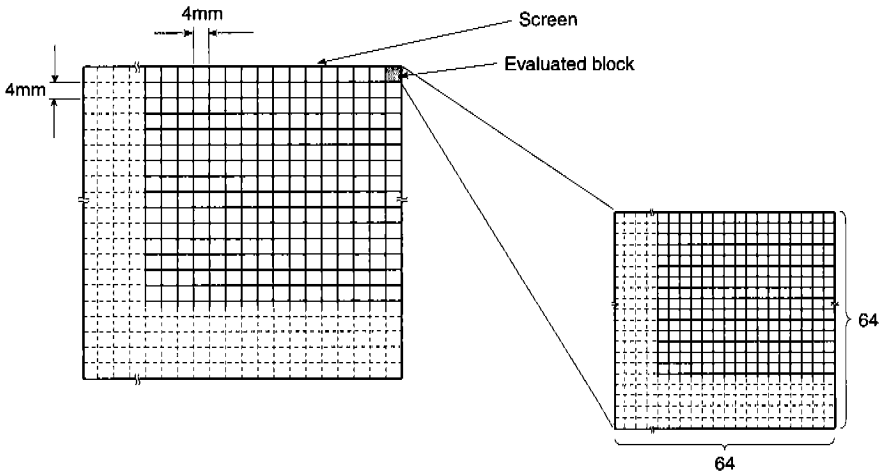

Fig. 2-42

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Processing is done from the final start up point to the first transition point as the frame.

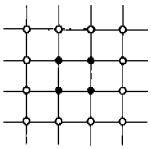
When doing the framing process in this manner, a border of approx. 4 mm is made.

c. Determining the print area

Isolated points are eliminated from the binary coded information.

The minimum unit which DC controller PCB recognizes as images made up of points is little squares formed by 2 of these points on the top, bottom, left and right.

The DC controller PCB recognizes the area of an image as indicated in the Fig. 2-43.

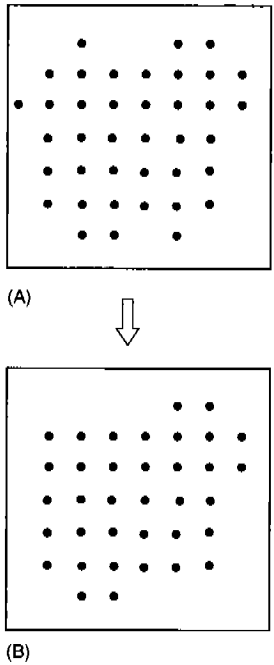


• Points above the slice level

○ Points below the slice level

Fig. 2-43

When image information such as in Fig. 2-44 (A) is gathered, those areas which do not satisfy the requirements for a minimum unit are eliminated, as in Fig. 2-44 (B).



(A)

(B)

Fig. 2-44

In cases such as when roll film is being used, the image shown in Fig. 2-45 is projected onto the screen. Only the image information projected onto the screen is detected.

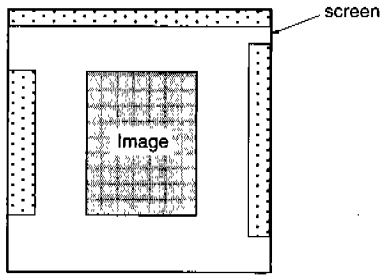


Fig. 2-45

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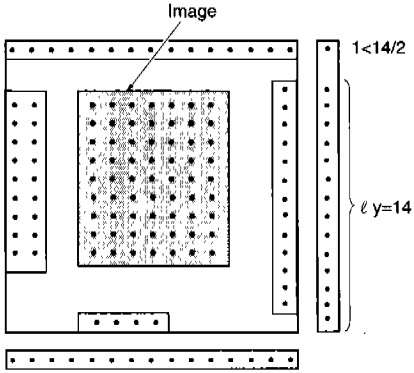

Fig. 2-46

The longest continuous image area of data in the Y direction, ℓy, is determined. (In this case, ℓy = 14.) (Fig. 2-46)

Primary image area data in the Y direction which is less than 1/2 x ℓy in length is excluded from the image area. (Fig. 2-47)

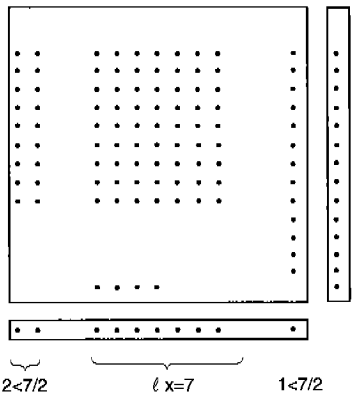

Fig. 2-47

Next, just as with the Y direction, the length of the longest continuous image area ℓx is determined. (In this case, ℓx = 7)

Primary image area data in the X direction which is less than 1/2 x ℓx in length is excluded from the image area. (Fig. 2-48)

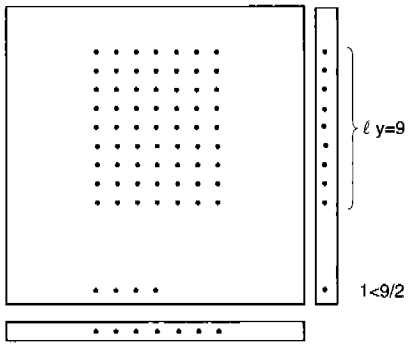

Fig. 2-48

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The end result of eliminating such image information in the Y direction is an image area like that shown in Fig. 2-49.

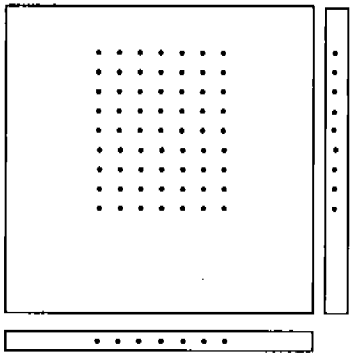

Fig. 2-49

The print image area after processing is to the image area (black frames of 4 mm and less remain), and to 4 - 8 mm outside the image area with black frames for Mode 1 and Mode 2, respectively.

Eventually, the image as shown in Fig. 2-50 is obtained.

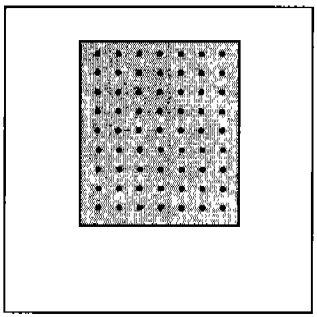

Fig. 2-50

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III. IMAGE ENCODING

1. Outline

As mentioned previously, the image data consists of "black" and "white" picture elements. The image data read by the BASIS can be output directly to a personal computer without problem. However, when it is recorded onto an external recording medium through the personal computer, the amount of data that can be recorded on a single disk is limited due to the capacity of the disk.

To overcome this, it is necessary to reduce the amount of data in the image of the document.

The reduction of the data contained in the image is called "encoding". The opposite process of restoring the encoded data to its original form is called "decoding".

2. Explanation

a. Outline

1) Encoding rate

The encoding rate is the ratio of the number of bits of data after encoding to the number of bits before encoding.

$$\text{Decoding rate} = \frac{\text{Number of bits of data after encoding}}{\text{Number of bits of data before encoding}}$$

2) One-dimensional encoding format (MH format)

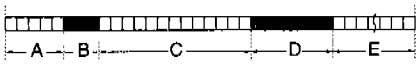

Figure 2-51

One "read" scanning line can be divided alternately into white parts and black parts. This corresponds to A to E in Figure 2-51. The number of picture elements in each of these sections is called the run length, or simply the run. The format of encoding used for encoding and sending the color (white or black) and run length of each of these sections is called run length encoding. The code used is a modified Huffman code, hence it is called Modified Huffman encoding format. (Also abbreviated to MH format.) This format is called a one-dimensional encoding format because it can only be encoded in the horizontal scanning direction (i.e. in one dimension) of a document which widens in one dimension.

3) Two-dimensional encoding (MR format)

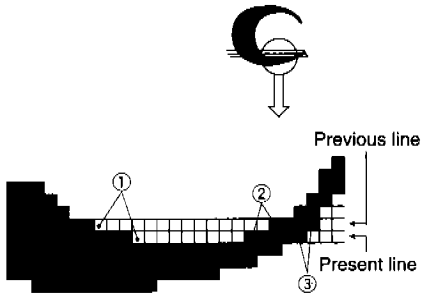

Figure 2-52

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By enlarging two continuous scanning lines such as those shown in Figure 2-52, then comparing the positions of the black/white boundary squares on the respective scanning lines, it can be seen that they are offset in the left-right direction. Specifically, this refers to parts ①, ②, and ③ in the figure. The format of encoding whereby the positions of the black/white boundary squares on one line are compared with the corresponding positions on the previous line, and the offset encoded, is called two-dimensional encoding.

The name "two-dimensional encoding" comes from the fact that the positions of the black/white boundary squares in the horizontal (left-right) scanning direction in one line are compared with those of the previous line in the vertical scanning direction.

This is called Modified Read encoding format. The word "READ" is an acronym meaning Relative Element Address Designative.

This format is used for documents with squarish characters such as Chinese characters.

This encoding format has the disadvantage that because encoding always proceeds while the data on one line is compared with that on the previous line, once an encoding error occurs it will affect the subsequent lines as well.

4) MMR format

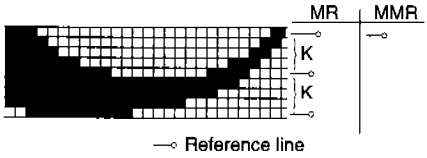

Figure 2-53

In the MR format, one line in every K lines (k parameter: described later) is encoded by one-dimensional encoding, and the remaining lines are encoded by two-dimensional encoding. In the MMR format (Modified Modified Read), all the lines will be encoded by two-dimensional encoding on the basis that there is one imaginary white line in all before the first line.

This encoding method results in a higher image compression rate than that of the MR format.

b. One-dimensional encoding formats

1) Run length

Looking at a single scanning line, it can be seen that it can be divided alternately into several white and black sections.

The sections A, B, C, D, and E in Figure 2-54 below are called runs. For example, section A is a white run.

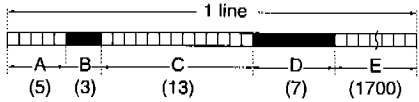

Figure 2-54

Run length of Figure 2-54 is as shown in Table 2-1.

Area	Run	Run Length
A	White run	5
B	Black run	3
C	White run	13
D	Black run	7
E	White run	1700
Total	—	1728

Table 2-1

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2) Terminating code and make-up code

When image data is being encoded, each line is encoded using Huffman code. A Huffman code consists of a terminating code and a make-up code.

Terminating codes

White run length	Code	Black run length	Code
0	00110101	0	0000110111
1	000111	1	010
2	0111	2	11
3	1000	3	10
4	1011	4	011
5	1100	5	0011
6	1110	6	0010
7	1111	7	00011
8	10011	8	000101
9	10100	9	000100
10	00111	10	0000100
54	00100	54	000000111000
55	01011000	55	000000100111
56	01011001	56	000000101000
57	01011010	57	000000101100
58	01011011	58	000000101001
59	01001010	59	000000101011
60	01001011	60	000000101100
61	00110010	61	000000101010
62	00110011	62	000000100110
63	00110100	63	000000100111

Table 2-2

Make-up codes

White run length	Code	Black run length	Code
64	11011	64	0000001111
128	10010	128	000011001000
192	010111	192	000011001001
256	0110111	256	000001011011
1536	01100110	1536	0000001011010
1600	010011010	1600	0000001011011
1664	011000	1664	0000001100100
1728	010011011	1728	0000001100101
EOL	000000000001	EOL	000000000001

Table 2-3

Make-up Codes (added)

Run length (white or black)	Make-up code
1792	00000001000
1856	00000001100
1920	00000001101
2496	00000011101
2560	000000011111

Table 2-4

3) Method of encoding

A read scanning line is divided into runs (A to D) as shown in Table 2-5, then each run is encoded as follows:

- When the run length is 63 or less

The sections with a run length of 63 or less are A, B, C, and D. These sections are encoded using only terminating codes.

In other words, the Huffman code for these runs consists of only a terminating code.

Part run	Run length	Make-up code	Terminating code	Huffman code
A White run	5	None	1100	1100
B Black run	3	None	10	10
C White run	3	None	000011	000011
D Black run	7	None	00011	00011

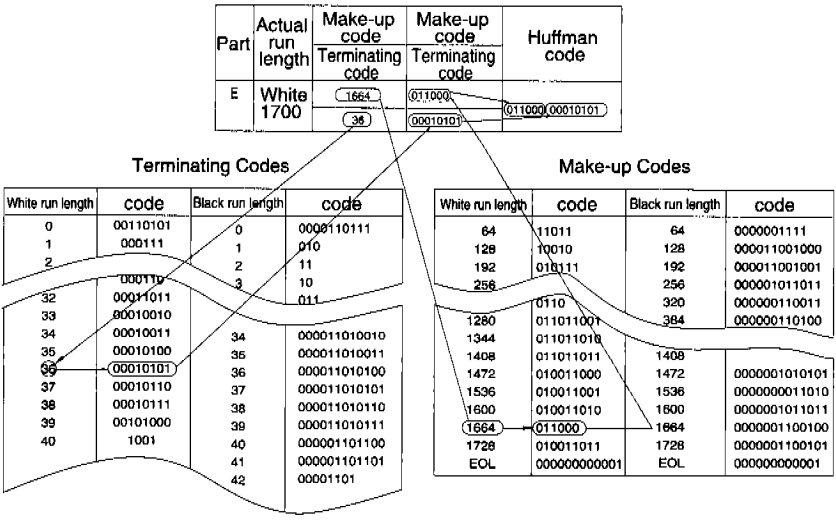
White run length	Code	Black run length	Code
0	00110101	0	0000110111
1	000111	1	010
2	0111	2	11
3	1000	3	10
4	1011	4	011
5	1100	5	0011
6	1110	6	0010
7	1111	7	00011
8	10011	8	000101
9	10100	9	000100
10	00111	10	0000100
11	01000	11	0000101
12	001000	12	0000111
13	000011	13	00000100
14	0100	14	00000111
		15	000011000
		16	0000011000
		17	0000001000

Table 2-5

- When the run length is 64 or more

These sections are encoded using one make-up code and one terminating code.

First, the machine refers to the make-up code table and finds a run length which is either smaller than or the same as the actual run length. Next, it refers to the terminating code table and finds the difference between the actual run length and the run length of the make-up code, then encodes the section.



White run length	code	Black run length	code
0	00110101	0	0000110111
1	000111	1	010
2		2	11
3	000110	3	10
32	00011011		011
33	00010010		
34	00010011	34	000011010010
35	00010100	35	000011010011
36	00010101	36	000011010100
37	00010110	37	000011010101
38	00010111	38	000011010110
39	00101000	39	000011010111
40	1001	40	000001101100
		41	000001101101
		42	00001101

White run length	code	Black run length	code
64	11011	64	0000001111
128	10010	128	000011001000
192	010111	192	000011001001
256		256	000001011011
	0110	320	000000110011
1280	011011001	384	000000110100
1344	011011010		
1408	011011011	1408	
1472	010011000	1472	0000001010101
1536	010011001	1536	0000000011010
1600	010011010	1600	0000001011011
1664	011000	1664	0000001100100
1728	010011011	1728	0000001100101
EOL	000000000001	EOL	000000000001

Table 2-6

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The encoding of one scanning line is as follows:

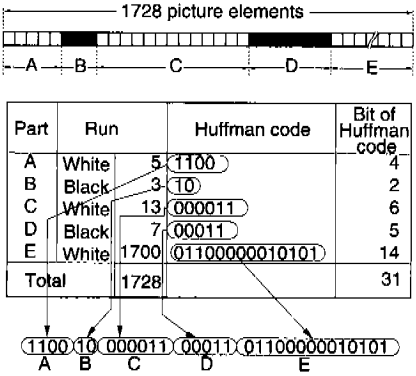

Table 2-7

In the above example, 1728 bits (one line of picture elements) are encoded into 31 bits, that is, the compression rate is

31 bits/1728 bits = approx. 1/56.

- When the run length agrees with the make-up code

Both a white run of 640 and a black run of 1088 correspond with values in the make-up code table. However, it is not possible to encode data using a make-up code alone, hence it is necessary to use a terminating code (run length 0) at the end run length of the make-up code.

White run 640 = White run 640 + White run 0
Make-up code Terminating code

- When the beginning of a scanning line is a black run

This machine is designed so that the encoding of a scanning line starts from white when a scanning line starts with a black run, as shown in Figure 2-55, a white run of run length zero, that is, a dummy run is inserted in front of the first run of the first scanning line before encoding takes place.

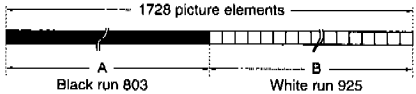

Figure 2-55

Run			Code	No. of data bits
Dummy	White	0	00110101	8 bits
A	Black	803	000000100110000 0011010011	25 bits
B	White	925	011010011000000 10	17 bits
Total run length		1728	No. of data bits	50 bits

When scanning line starts with black line

Table 2-8

- EOL

The EOL (End of Line) shown in the make-up code table is called a line terminating code. It is code which indicates the end of a line.

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c. Two-dimensional encoding format

1) Reference line and encoding line

In a two-dimensional encoding method, encoding proceeds while the present line is compared with the previous line. Consequently, the line presently being encoded is called the encoding line, and the previous line is called the reference line.

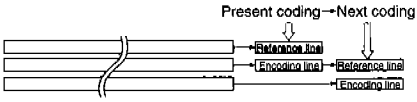

Figure 2-56

2) Parameter K

As mentioned above, two-dimensional encoding takes place while the present line is compared with the previous line. Consequently, the scanning lines on one page are gathered into groups of several lines each. The first line is encoded by one-dimensional encoding, as mentioned above, and the subsequent lines are encoded by two-dimensional encoding while the data in the present line is compared with that of the previous line. The number of lines in a group is called parameter K. (Used with the MR format.)

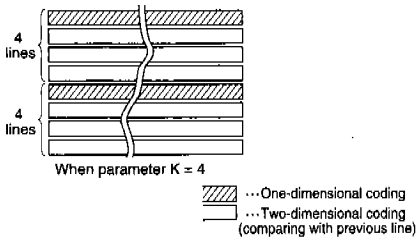

Figure 2-57

3) Change picture element

A picture element whose immediately preceding picture element and color (white or black) are different is called a change picture element. In other words, a change picture element is the first picture element of each run.

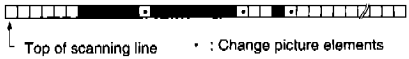

Figure 2-58

4) Relative distance

Relative distance is the distance between one picture element, taken as a datum, and another.

The side to the right of the datum picture element is the plus side, and the side to the left of it is the minus side. The two picture elements may sometimes lie on the same scanning line, or on different scanning lines.

For example, in Figure 2-59, if "a" is taken as the reference, the relative distances of "b," "c," and "d" from "a" are as follows:

ab = 4

ac = -5

ad = 0

Assume, for example, that the absolute value of a relative distance is |5|.

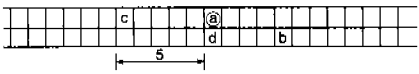

Figure 2-59

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The absolute value of the relative distance is simply the distance between two picture elements, without using either of them as a datum.

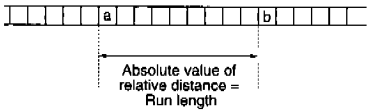

Figure 2-60

The absolute value of the relative distance is the same as the run length from "a," including "a," to a point immediately before "b," as shown in Figure 2-60.

5) Necessary picture elements for encoding

Encoding takes place after the picture elements a0, a1, a2, b1, and b2 on the encoding line and reference line have been determined.

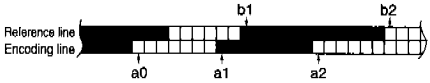

Figure 2-61

First, the position of a0 is determined, then the positions of the remaining picture elements (a1, a2, b1, and b2) are determined.

a0: This is the reference picture element or starting point change picture on the encoding line. This position is determined by the previously executed encoding mode.
Assume that the white picture element immediately before the actual picture element is a white picture element and that it is a0.

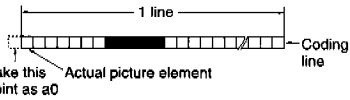

Figure 2-62

a1: First change picture element to the right of a0 on the encoding line

a2: First change picture element to the right of a1 on the encoding line

b1: First change picture element of the opposite color to a0 on the right of a0, on the reference line.

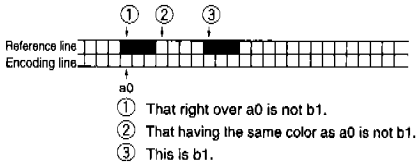

Figure 2-63

d. Encoding mode

From the positional relationship between a0, a1, a2, b1, and b2 on the reference line and encoding line, encoding takes place in one of three encoding modes.

1) Pass mode

This mode is used when b2 is on the left of a1, as shown in Figure 2-64. Encoding in this mode takes place with the code "0001" (P is used as a symbol). After encoding has taken place, a0 is moved to the picture element on the encoding line immediately below b1 (i.e. 0') in preparation for the next encoding operation.

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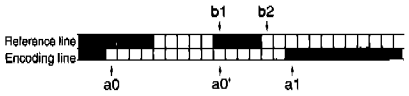

Figure 2-64

However, if b2 is directly above a1, the pass mode is not used.

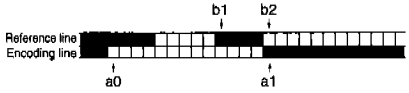

Figure 2-65

2) Vertical mode

This mode is used when the pass is not used and the absolute value | a1 b1 | of the relative distance between b1 and a1 is no more than 3.

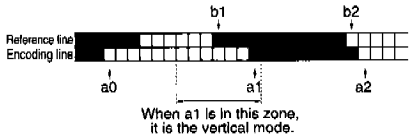

Figure 2-66

During the encoding process, the relative distance between a1 and b1 is expressed using the following symbols.

V(0)...a1 is directly beneath b1

VR(n)...a1 is on the right of b1

VL(n)...a1 is on the left of b1

Where n is the absolute value of the relative distance between a1 and b1.

n = 1,2,3

After encoding, the position of a1 becomes the position of the new a0, in preparation for the next encoding operation.

3) Horizontal mode

This mode is used when neither the pass mode nor the vertical mode is used and the absolute value | a1b1 | of the relative distance between b1 and a1 is 3 or more.

In this mode, encoding is performed by inserting the absolute value of the relative distance | a0a1 | and |a1a2 | with Huffman code M (a0a1) and M (a1a2) after code "001" (expressed using symbol H) which represents the horizontal mode.

M(a0a1) is the Huffman code of run length of the color which contains a0, and M(a1a2) is the Huffman code of run length of the color which contains a1.

The Huffman code is exactly the same code as that used in one-dimensional encoding.

After encoding, the position of a2 becomes the position of a0, in preparation for the next encoding operation.

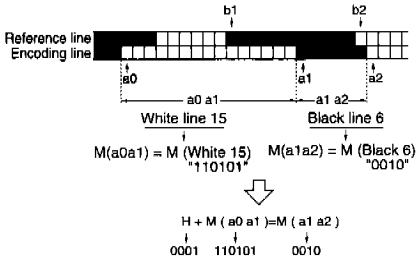

Figure 2-67

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e. Encoding procedure

The encoding procedure determines which of the following three encoding modes is to be used. After the encoding mode has been determined, encoding takes place using the code in Table 2-9. The encoding procedure is shown in the flowchart of Figure 2-68.

Procedure 1

① When the pass mode is detected, encoding takes place with code "0001". Subsequently, picture element a0' directly below b1 becomes the new a0, in preparation for the next encoding operation.

② If the pass mode is not detected, the program proceeds to procedure 2.

Procedure 2

① The absolute value of the relative distance a1b1 is calculated.

② If | a1b1 ≦3, a1b1 is encoded using the vertical mode. After encoding, a1 becomes the new a0, in preparation for the next encoding operation.

③ If | a1b1 ≧3, run lengths a0a1 and a1a2 are encoded using one-dimensional encoding after code "001" which indicates the horizontal mode. Subsequently, a2 becomes the new a0, in preparation for the next encoding operation.

Mode	Code		Mark	Code
Pass	b1b2		P	0001
Horizontal	a0a1, a1a2		H	001+M (a0a1) +M (a1a2) Note
Vertical	a1 just below b1	a1b1=0	V (0)	1
	a1 is at right of b1	a1b1=1	VR (1)	011
		a1b1=2	VR (2)	000011
		a1b1=3	VR (3)	0000011
	a1 is at left of b1	a1b1=1	VL (1)	010
		a1b1=2	VL (2)	000010
		a1b1=3	VL (3)	0000010

Note: Those in parenthesis refer to the code in Tables 2-2, -3, and -4.

Table 2-9

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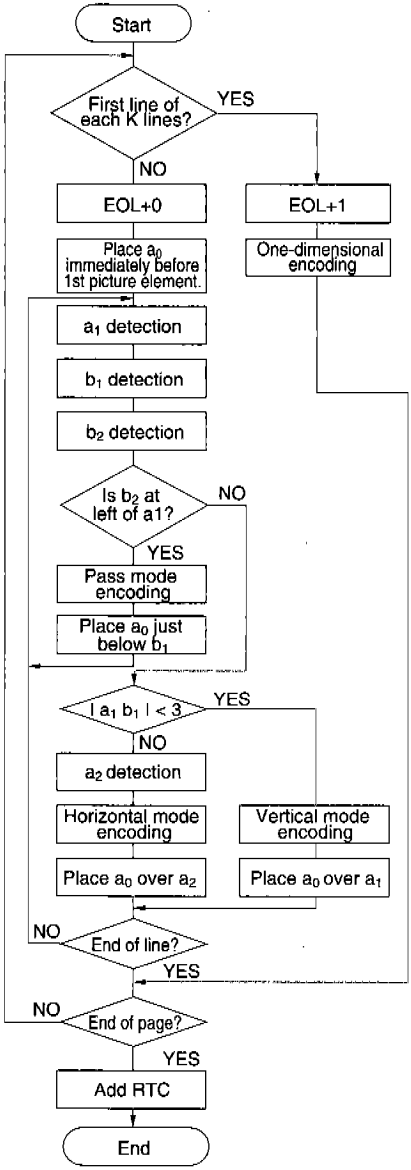

RTC means the signal that indicates end of one page of image.

Figure 2-68

f. Start and end of encoding line

1) Processing at the start of the encoding line

At the start of the encoding line, it is assumed that a white picture element exists immediately before an actual picture element, and a0 is placed immediately over it.

Figure 2-69

Because a0 is not located above an actual picture element, the first run length, a0a1, of the line is replaced by a0a1-1. As shown in Figure 2-69, a0a1 is white run length 8, however the actual number of picture elements is only 7. Consequently, a0a1 is replaced by a0a1-1, that is, by 7.

As a result, the first picture element of the encoding line is black, as shown in Figure 2-70, and if the line is encoded in the horizontal mode, M(a0a1) will be white run 0.

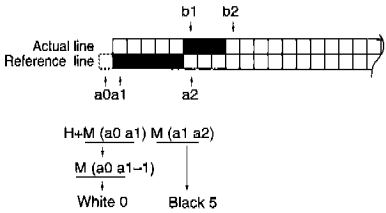

Figure 2-70

When the encoding line shown in Figure 2-71 starts with a black picture element:

Figure 2-71 shows an example of encoding the first part of the scanning line.

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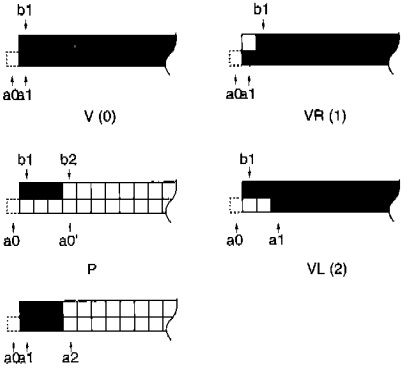

Figure 2-71

2) Processing at the end of the encoding line

At the end of the encoding line, it is assumed that a picture element of the opposite color to that of the last picture element on the actual encoding line exists. Encoding continues until the opposition of this picture element is encoded.

Figure 2-72

This picture element is encoded as a1 in the vertical mode, and as a1 or a2 in the horizontal mode. If neither b1 nor b2 is detected at an actual picture element on the reference line, or if b2 only is detected, b1 or b2 will be replaced immediately after the last picture element on the reference line.

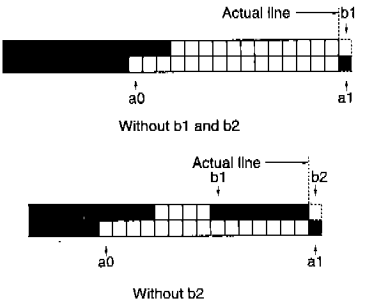

Figure 2-73

An example of encoding of the scanning line end is shown in Figure 2-74.

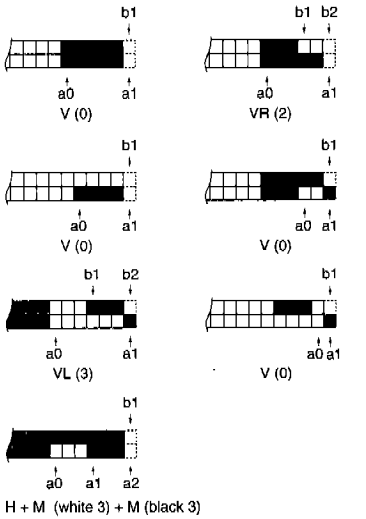

Figure 2-74

I. BASIC OPERATION

1. Functions

The functions of this machine can be broadly classified into the following three sections: Exposure system, Image processing system, Control system.

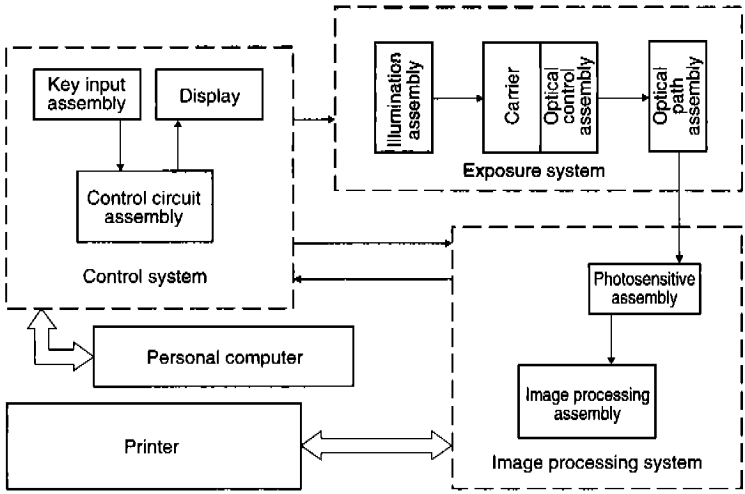

Fig. 3-1

2. Main Drive

This machine has an optical drive system for image scanning and uses a DC motor (M1).

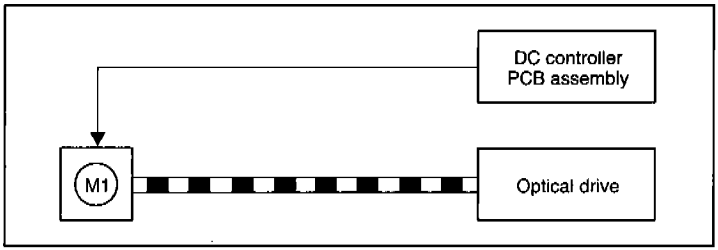

Fig. 3-2

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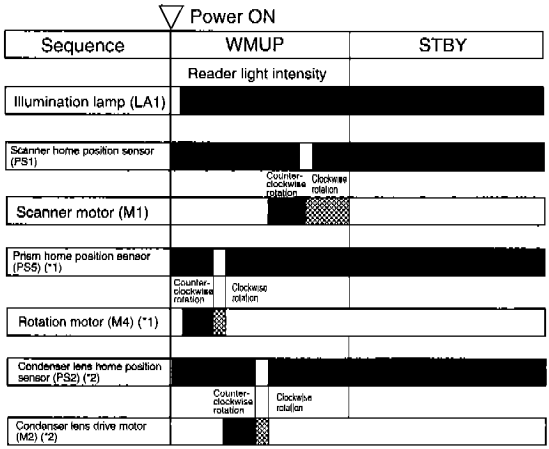
3. Basic Sequence

a. Basic sequence when the power is ON



(*1) : Creating the home position with MS500. Can be eliminated in the service mode.
(*2) : Creating the home position with MS500.

Fig. 3-3

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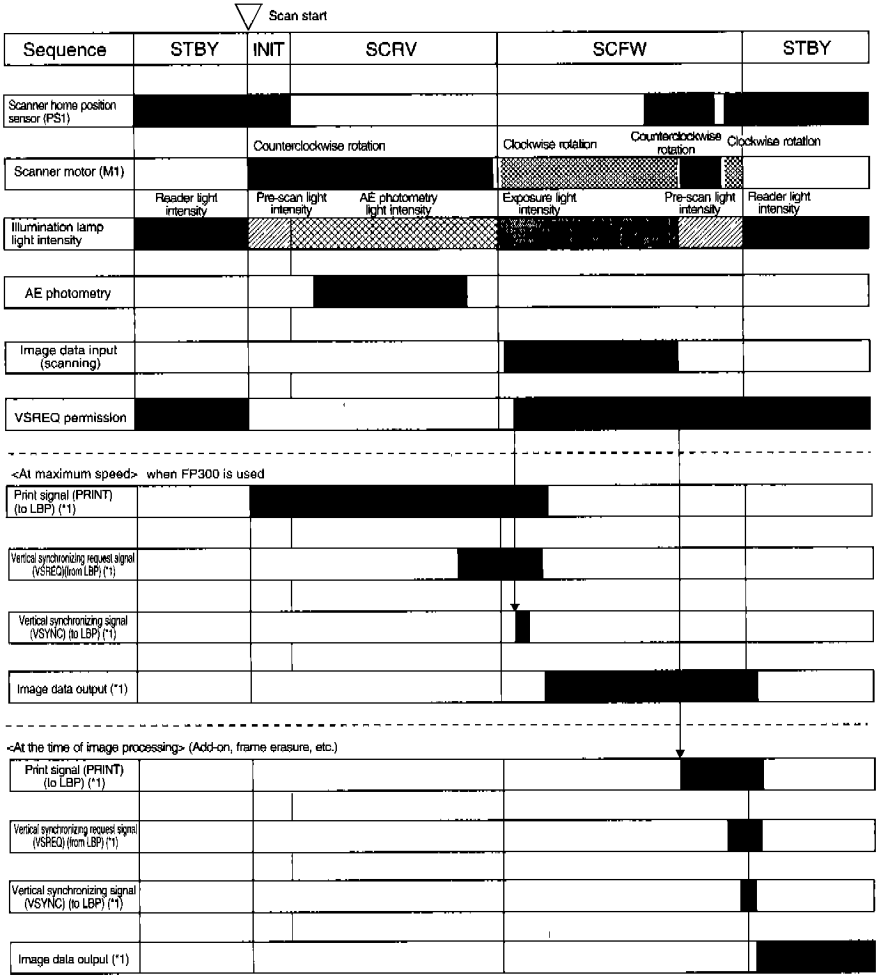
b. Print Sequence



(*1) : Does not operate when SCSI outputs.

Fig. 3-4

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Duration		Purpose	Remarks
STBY (Standby)	The period of time during which the optical system is moving to the home position.	• Moves the optical system to the home position. • Lights the illumination lamp.	
INIT (Initialization operation)	Until the optical system moves away from the home position while the scanning is in operation.	• Moves the second mirror to the print position.	
SCRV (Optical system retract)	The period of time during which the optical system retracts.	• Measures AE.	Operate AE photometry only when print the first page.
SCFW (Optical system advance)	The period of time during which the optical system advances.	• Irradiates the film with the illumination lamp and projects the transmitted optical image to BASIS. • Returns No. 2 mirror to the leader position.	Scanning

Table 3-1

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II. OPTICAL SYSTEM

A. Outline of Optical System

The magnifications of irradiated to BASIS and projected to the screen are changed by the focal length of the lenses.

B. Optical Path System

The optical path when the transmitted image on the film that is irradiated by the illumination lamp is projected on the screen or the photo electric conversion device (BASIS) is shown in Fig. 3-5.

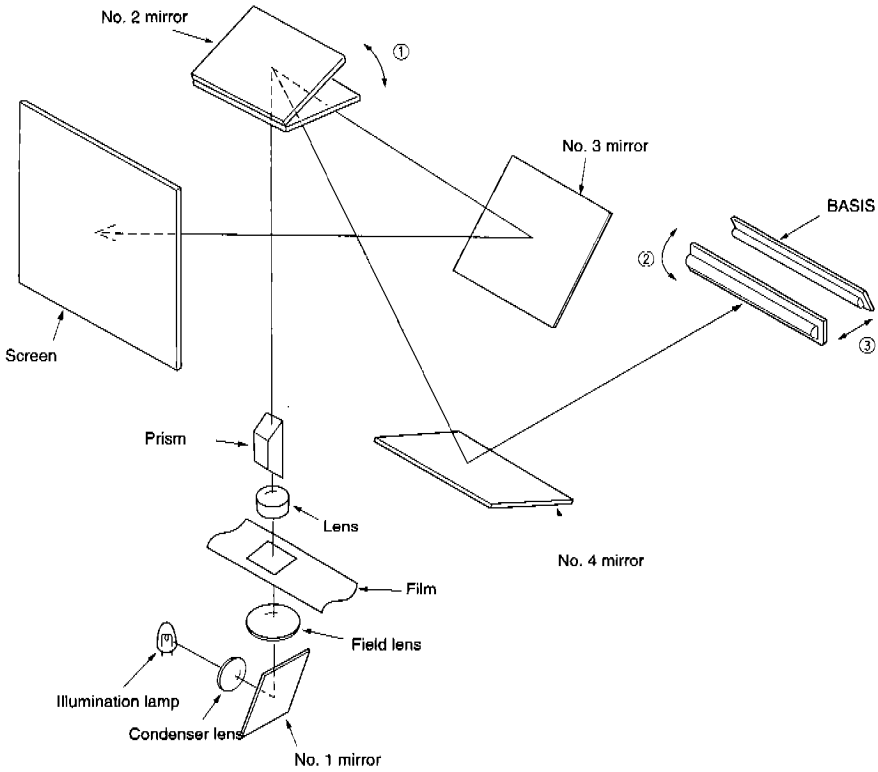

Fig. 3-5

During the Reading

The film placed on the carrier glass surface is irradiated by the illumination lamp (halogen lamp) and the transmitted image of the film is projected through the lenses, prism and mirrors to the screen.

During the Scan

Since No. 2 mirror moves downward during the scan, the transmitted image of the film is projected on the BASIS.

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C. SCANNER DRIVE

Figure 3-6 is a rough drawing (cross section) of the optical system.

①, ② and ③ of the optical system shown in the above drawing carry out scanning and scanning compensation.

① Scanning (scanner mirror: No.2 mirror) and speed compensation
No.2 mirror (scanner mirror) is rotated to scan the image on the film.
Also, speed compensation is carried out to make the scanning speed uniform.

② Optical path length compensation (slide mount)
The optical path length is compensated by moving the BASIS proper back and forth.

③ Incident angle compensation (sensor holder)
Compensates the angle of incidence entering the BASIS itself to make it perpendicular.

Details will be described later.

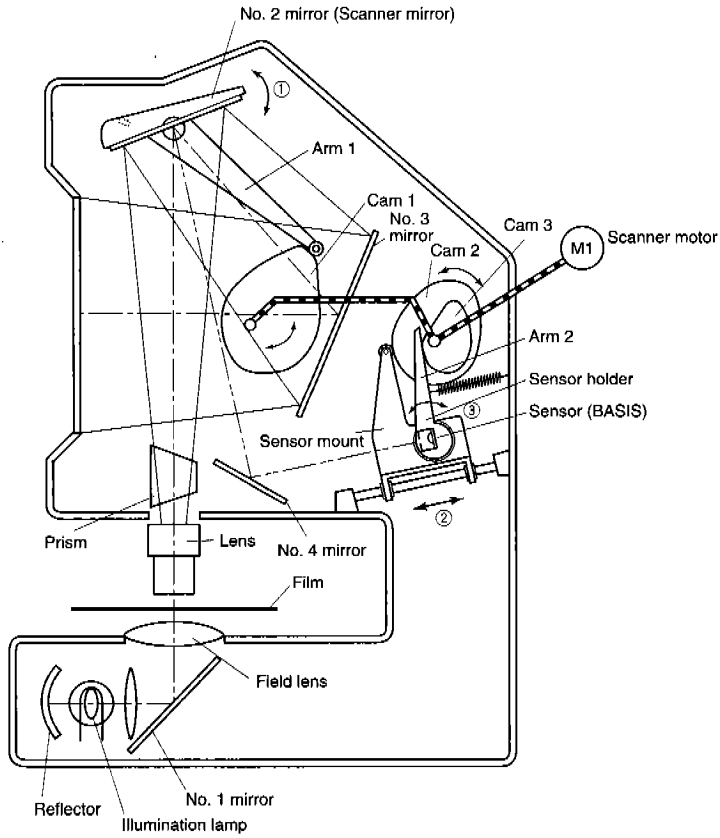

Fig. 3-6

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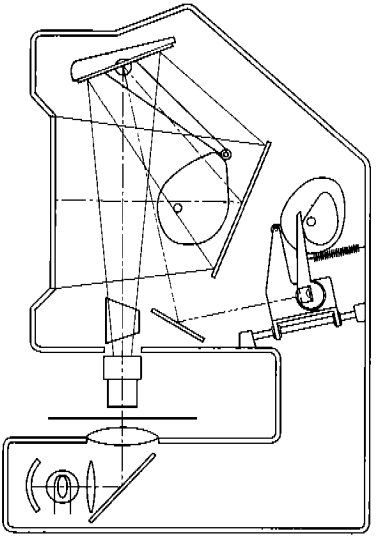

Fig. 3-7 During reading

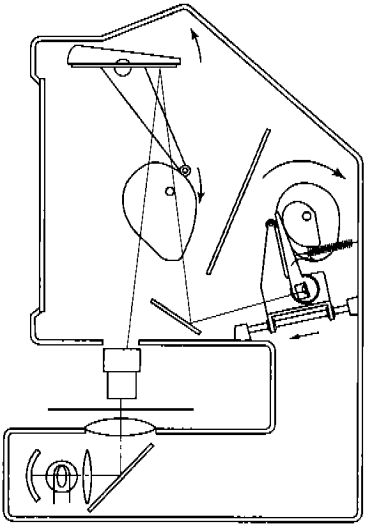

Fig. 3-8 At start of scanning

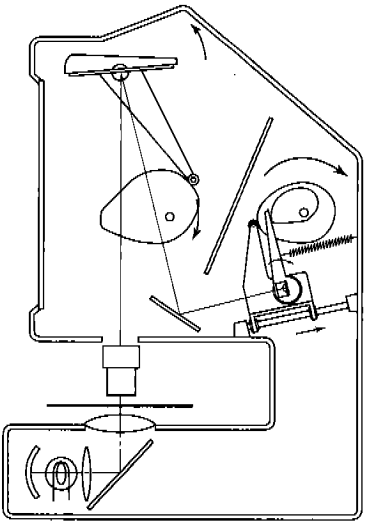

Fig. 3-9 During scanning

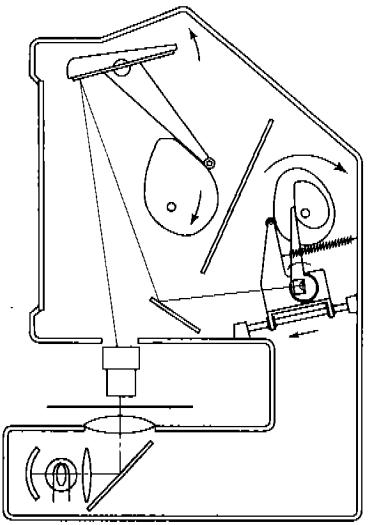

Fig. 3-10 After scanning

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The scanner motor (M1) drive is transmitted to cam 1 and cam 2 via gears.

The rotation of cam 1 is linked to the roller of arm 1 causing it to move up and down on cam 1 thus making the No.2 mirror (scanner mirror) turn. At the same time, cam 2 also rotates causing the sensor mount and sensor holder arm to be pushed so that the sensor mount moves back and forth and the sensor holder turns.

Next, we give herewith an explanation of the movements of the optical system.

Figure 3-7 shows the image of the film projected on the screen. (Reader state)

When scanning begins, the scanner mirror (No.2 mirror) turns clockwise. (Fig. 3-8)

The sensor mount moves to the far position with BASIS facing furthest down.

When scanning nears the middle of the image, BASIS faces slightly up and the sensor mount moves to a closer position. (Fig. 3-9)

When the edge of the image is reached, BASIS faces up and the sensor mount moves to an even closer position. (Fig. 3-10)

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D. Optical Compensation

Next, we give an explanation of the scanning and optical compensation.

Figure 3-11① shows the scanning state.

The image on the film is scanned by turning No.2 mirror (scanner mirror).

Also, since simply transmitting the motor drive power to No.2 mirror will cause the image to be distorted, it is transmitted via a cam to turn No.2 mirror so that the scan speed becomes uniform.

Figure 3-11② shows compensation of the light path length. When scanning is carried out with the sensor in the fixed state, the distance from the sensor to film varies causing the image to be deformed. Because of this, the sensor mount is moved in accordance with the scanning so that the position from the lens to the BASIS is constant.

Figure 3-11③ shows compensation of the angle of incidence. The sensor holder is turned so that the incident angle from the film is constant. The effect of any dust or dirt adhering to the sensor is avoided as much as possible by making the incident angle from the film constant.

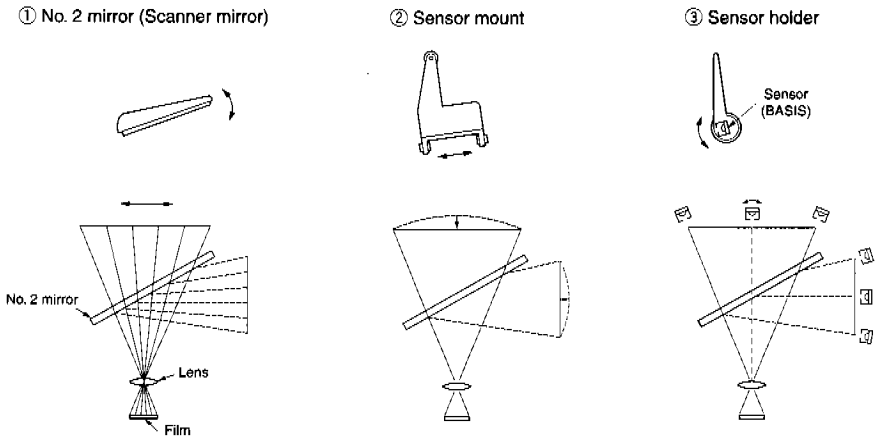

Fig. 3-11

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E. Light Intensity Compensation

1. Outline

As MS400/MS500 handle a wide range of magnification ratios from ×7 to ×55, if printing is done without any compensation, uneven density occurs. For this reason, uneven light intensity is corrected depending on the lens magnification ratio.

2. Light Intensity Compensation

Uneven light intensity is corrected by moving the field lens and drawing in and out the condenser lens of the illumination unit. (Refer to Fig. 3-12)

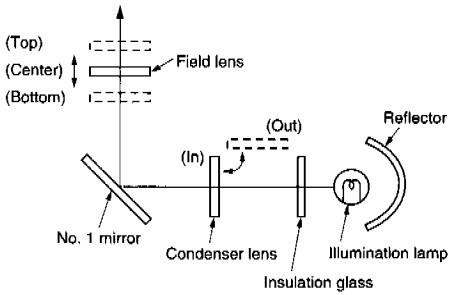

Fig. 3-12

This compensation is done automatically on the MS500 by sensing the magnification ratio of the lens and manually on the MS400 (by turning the light intensity adjustment dial).

Compensation is done by a combination of the field lens in 3 steps depending on its magnification ratio and the condenser lens in 2 steps, in/out.

Figure 3-13 and Table 3-2 shows the parameters in accordance with the positions of the light intensity adjustment dial on MS400 (in the case of MS500, the light intensity compensating drive gear) and the various magnification ratios.

No.	Field lens	Condenser lens	Magnification
①	Top	Out	×7
②	Center	Out	×9.5–×11.5
③	Bottom	Out	×11.5–×16
④	Center	Out	×15–×32
⑤	Bottom	In	×32–×45
⑥	Bottom	In	×45–×55

(Parameters are the same for both ⑤ and ⑥.)

Table 3-2

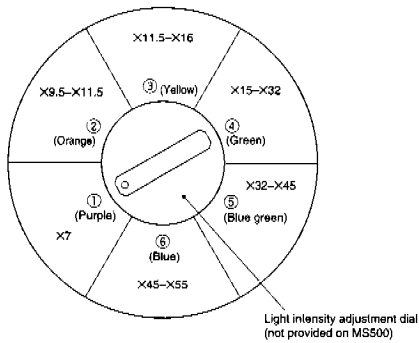

Fig. 3-13

Next, in Fig. 3-14 is shown the schematic diagram of uneven light intensity compensation.

Rotation of the light intensity compensating drive gear on MS500 is done by the condenser lens drive motor (M2). On MS400, the light intensity adjustment dial is turned manually.

Three signal plates are attached to the light intensity compensating drive gear to sense the rotating position of the gear. On MS400, the rotating position is detected with three sensors and on MS500, with one PS2.

As the light intensity compensating drive gear and cams 1 and 2 are an integral unit, cams 1 and 2 rotate at the same time as the light intensity compensating gear rotates.

As cam 1 has three step heights, the field lens moves up and down in three steps.

Also, by cam 2 rotating, the lens drive arm rotates and in turn the condenser lens rotates so that the condenser lens is drawn in and out on the light path.

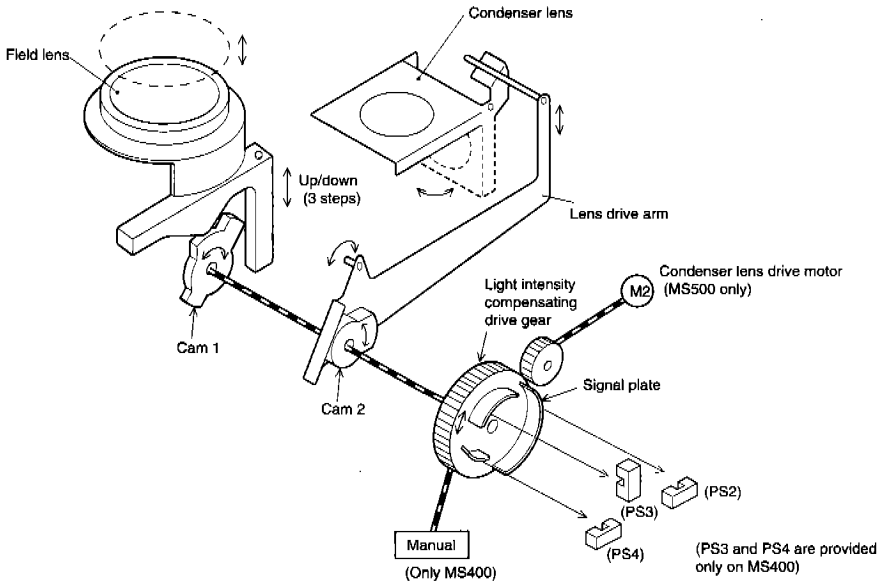

Fig. 3-14

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III. OUTLINE OF ELECTRICAL CIRCUITS

The main electrical control of the machine is executed by a microprocessor on the DC controller.

DC controller

Q102

- Sequence control
- Image data control
- Communication with external devices

The microprocessor reads the signals from the sensors and operation keys in accordance with programs store in it, and outputs the necessary signals to loads such as motors and circuits in other PCB assemblies, whenever required.

The microprocessor on the DC controller is connected to ROM and RAM.

The ROM contains programs which control communication with external devices and also the sequence of operation of the MS400/MS500. The RAM contains add-on data, service modes, and other data.

A lithium battery is provided to prevent the contents of the RAM from being destroyed when the power is turned OFF.

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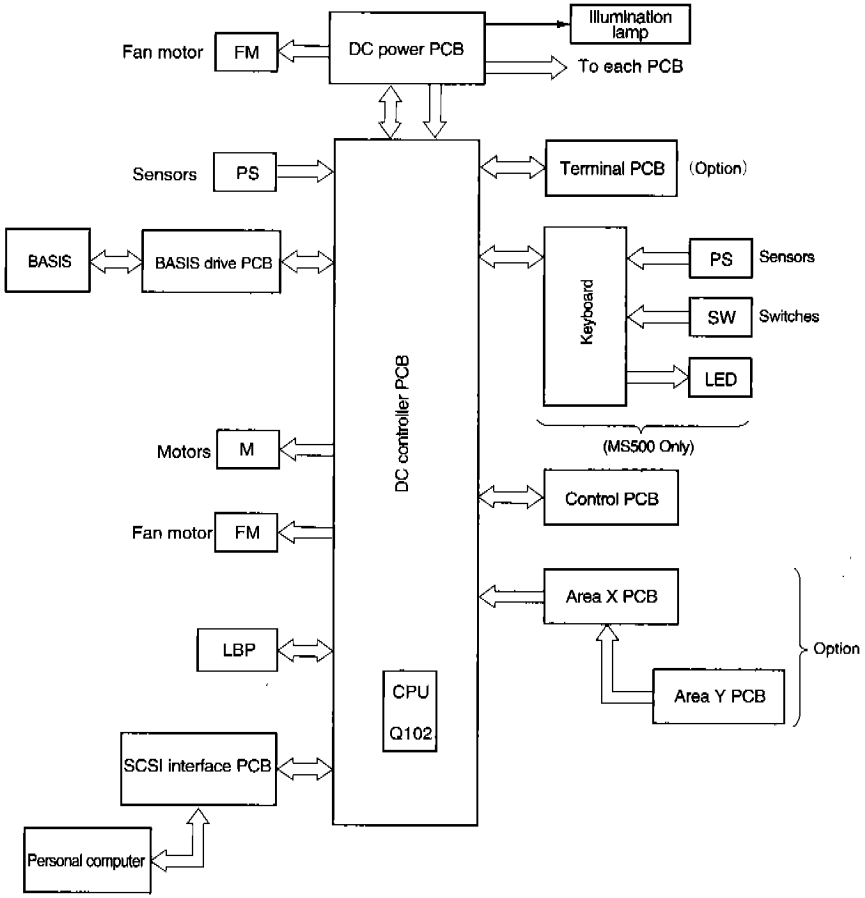

Fig. 3-15

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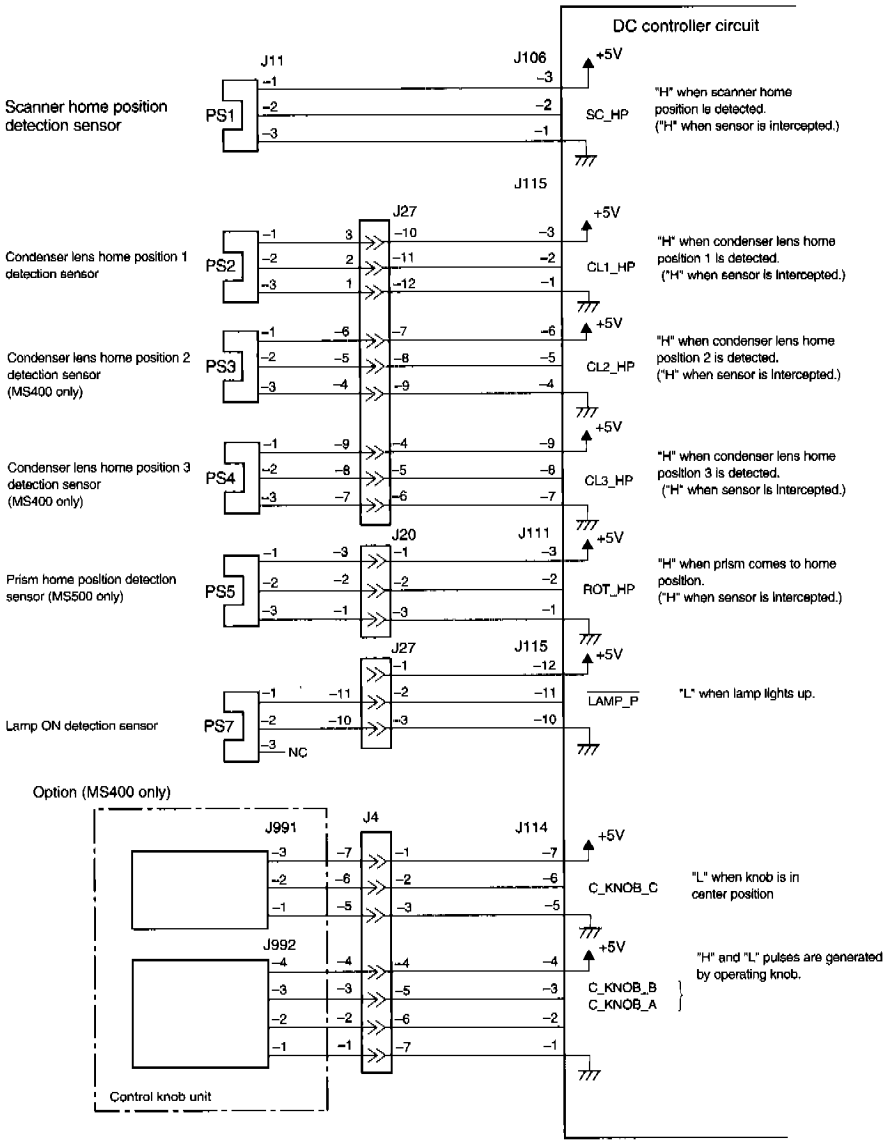
IV. DC CONTROLLER I/O



Note : PS6 is missing number.

Fig. 3-16

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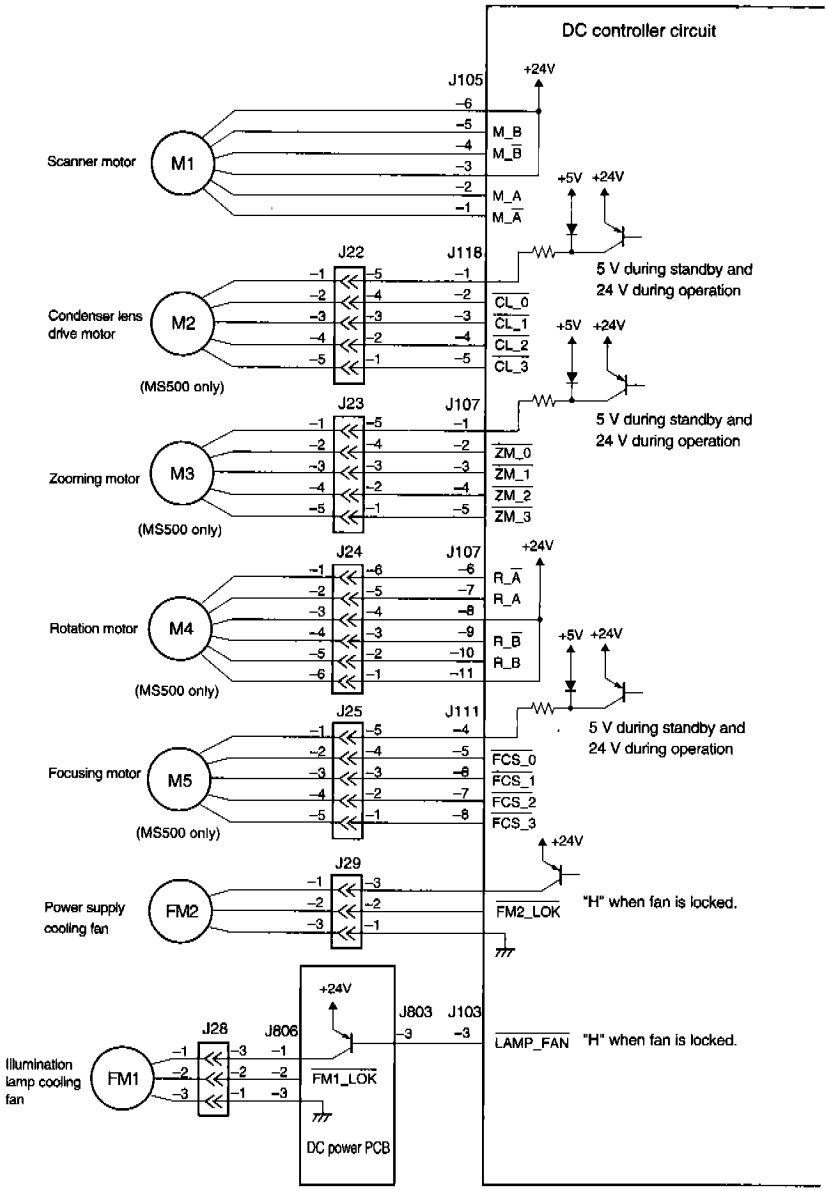

Fig. 3-17

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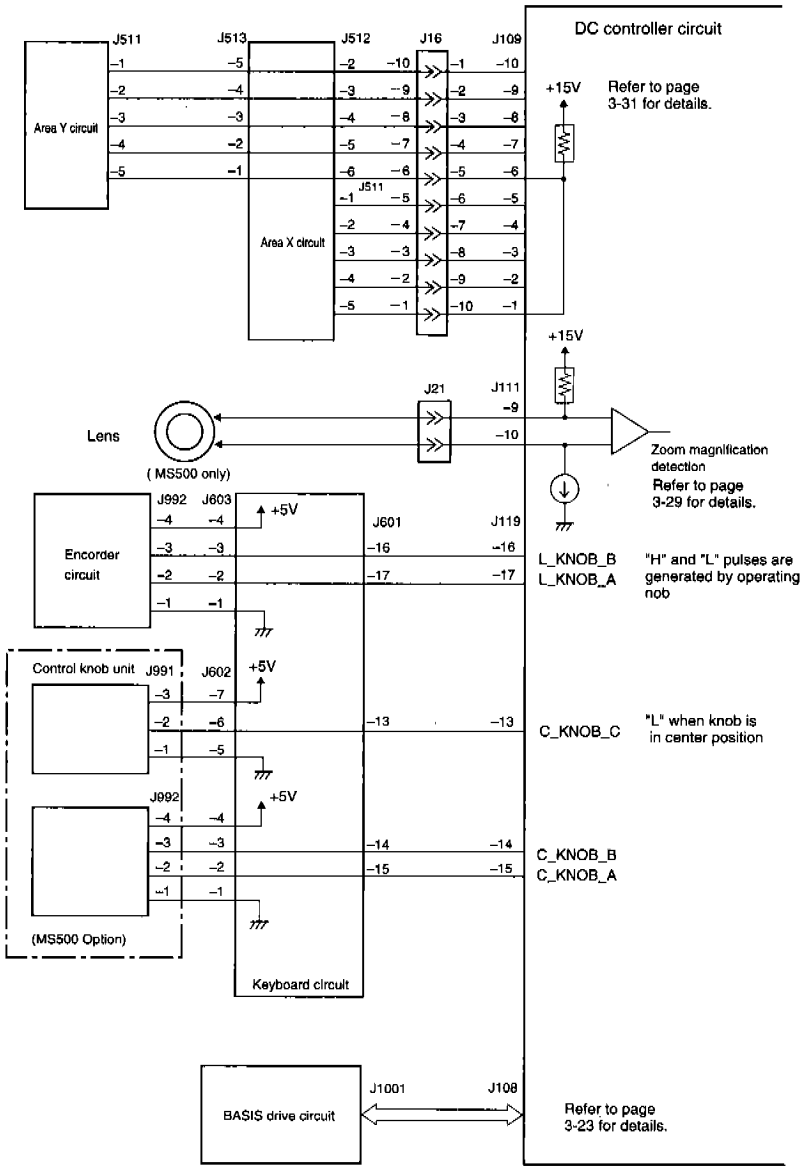
DC controller circuit
J511
J513
J512
J16
J109
Area Y circuit
Area X circuit
+15V
Refer to page 3-31 for details.
Lens
(MS500 only)
J21
J111
Zoom magnification detection
Refer to page 3-29 for details.
Encorder circuit
J992
J603
J601
J119
+5V
L_KNOB_B
L_KNOB_A
"H" and "L" pulses are generated by operating nob
Control knob unit
J991
J602
C_KNOB_C
"L" when knob is in center position
C_KNOB_B
C_KNOB_A
(MS500 Option)
Keyboard circuit
BASIS drive circuit
J1001
J108
Refer to page 3-23 for details.

Fig. 3-18

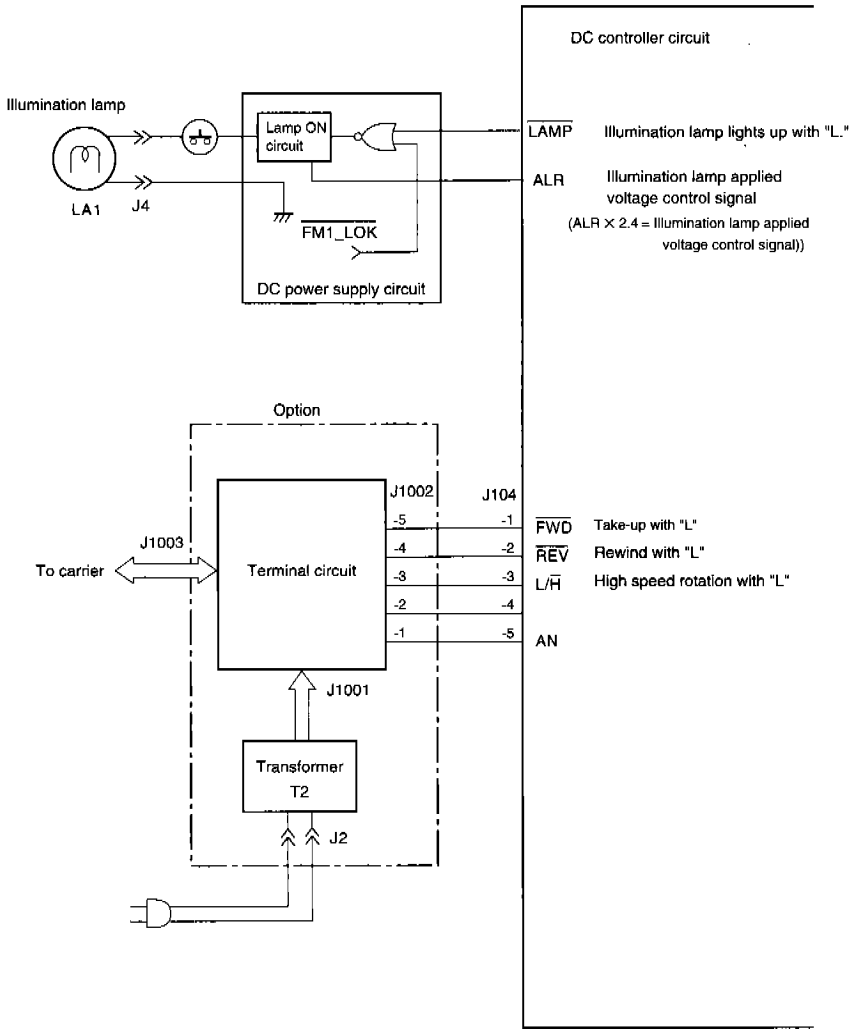

Fig. 3-19

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V. DESCRIPTION OF ELECTRICAL CIRCUITS

A. Outline

Figure 3-20 shows the block diagram of the CPU circuit based on the flow of image data.

A series of the analog signal output from the BASIS and output to external devices through the image processor is shown.

The block diagram indicates the main functions of the machine in the units of devices.

The [ ] in the frame indicates the name of the device used in each gate array.

1. Explanation of Operation

The electric signals sent successively from BASIS are sent to the image data sampling block. The signals, after being amplified by the image data sampling block are A/D converted by the A/D converter to become 8-bit digital signals, then compensated for shading and γ, and sent to PEAK chip.

At this PEAK chip, edge emphasis and frame erasure processing are carried out. Communication with the keyboard and driving of the condenser lens motor are also carried out.

At GENESIS-XF error diffusing process is done; the IF-XF chip has a reduction function (only in the main scanning direction) of binarized image and transmits by DMA 16 bits each of the binarized image, via the internal memory, to the DRAM of the CPU bus. Also, with DMA, it has the same sort of circuit as magnification/reduction (only in the main scanning direction) and outputs to the printer through this circuit. Magnification/reduction, using the memory, carries out through simple thinning out and double typing by changing the writing or reading clock.

After passing through this circuit, the data is packed in 16-bit each and DMA transmitted, via memory, to DRAM of the CPU bus. In case of print, they are DMA transmitted from the DRAM on the CPU bus to the built-in memory. From this memory, in case of magnification, the data is read out by the thinned out clock, parallel/serial converted and printed out.

The optional SCSI board consists of the M-ENC chip which carries out image compression of MH, HR, and MMR, the SCSI chip which carries out control of the SCSI, and the SORAMAME chip which acts as the interface between these LSI and the CPU.

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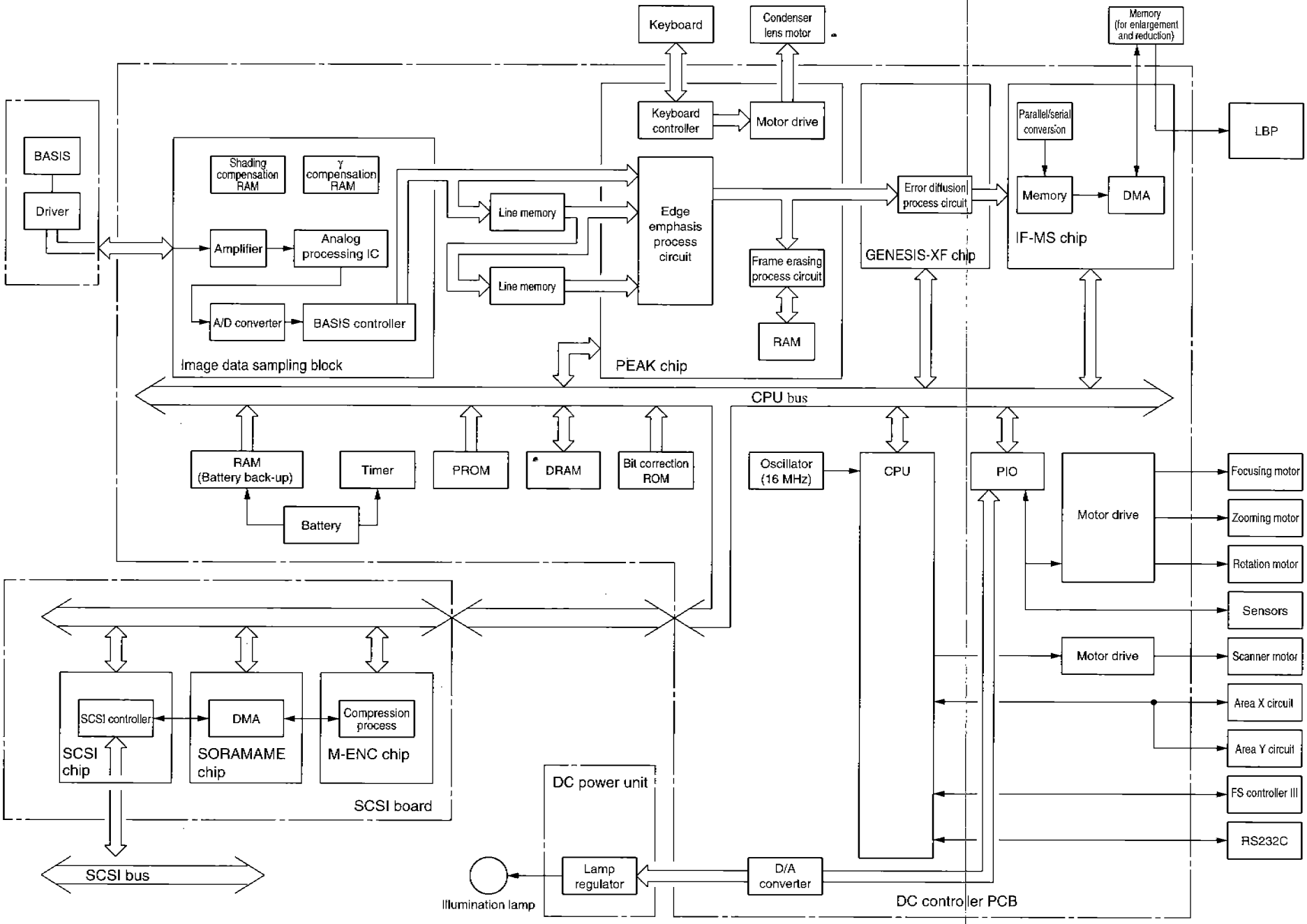

Fig. 3-20

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B. BASIS Drive Circuit

1. Outline

The circuit shown in Fig. 3-21, amplifies the voltage (analog) of each picture element output from BASIS and converts it to an eight bit digital signal.

2. BASIS operation

The BASIS (Base Stored Image Sensor) used in this machine has 3476 bits as picture elements BASIS consists of a photosensitive assembly, transfer assembly, and output assembly.

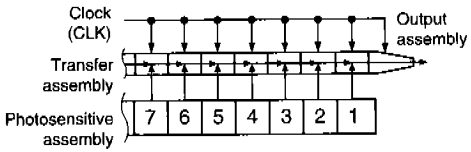

Fig. 3-21

① **BASIS Construction**

The BASIS construction is shown in Fig. 3-22.

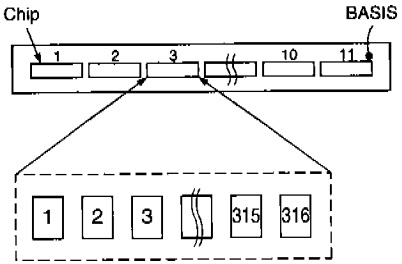

Fig. 3-22

BASIS consists of eleven chips. There are 316 sensors (phototransistors) arranged in each chip.

In other words, the BASIS sensor consists of 11 × 316 = 3476 bits. It is possible to scan at 400 dpi.

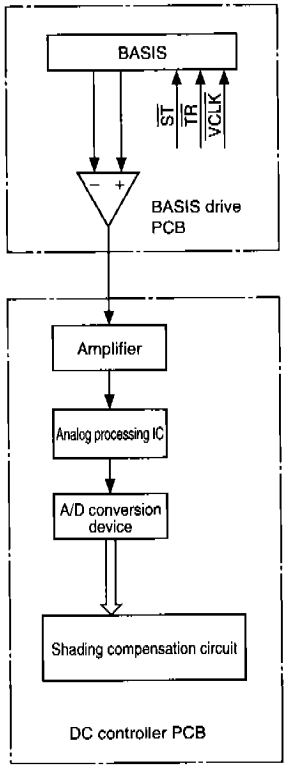

Fig. 3-23

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② **BASIS transfer assembly**

When the A/D CLK is ON, the previously held electrical potential is synchronized with the GCLK clock and transferred sequentially to the output. (Analog shift register)

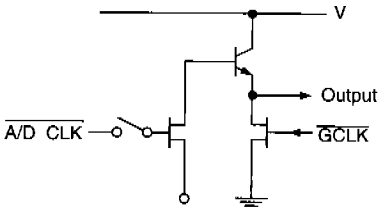

Fig. 3-24

Figure 3-25 shows the internal timing chart of the sensor amplifier circuit.

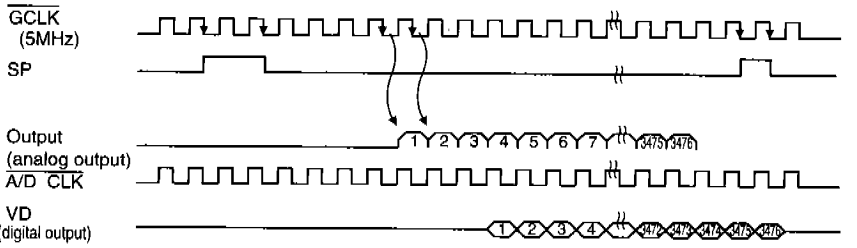

Fig. 3-25

The GCLK clock outputs an analog signal from the BASIS in synchronization of the A/D CLK signal.

The SP signal determines the scanning start timing.

The black level signal used by the analog processing IC suppresses variations in the black level of the BASIS by clamping it in every line.

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3. Sensor Amplifier Circuit Operation

The image on the film is scanned by BASIS. BASIS then outputs the signal corresponding to the image density and the dark signal that does not irradiate any light.

Those signals are amplified by a differential amplifier to become signals of a maximum of 600mV and are input into the amplifier. The gain of signal is adjusted to become approximately 2.6 V by the latter stage amplifier and amplification with the analog processing IC.

These signals are converted into 8-bit digital signals by the A/D converter and output to the DC controller circuit. Also, the $\overline{\text{GHSEL}}$ signals input into the amplifier are signals for amplifying five times (normally three times) the signals from the differential amplifier for use as AE light measuring when scanning.

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C. Compensation for Bit/ Shading Circuit

The shading compensation circuit is shown in Fig. 3-26.

This machine, unlike other scanners that read originals, is not provided with a standard (example: standard white color sheet, etc.) for compensating each bit of the sensor (BASIS) because it sees transmitted light.

Therefore, when it is shipped from the factory it must contain data that has been compensated for each output level of each BASIS.

The memory that is storing this data is ROM 1. (The data differs depending on each machine)

Also, since the light intensity distribution differs depending on the magnification ratio of the lens, these compensated data are stored in PROM. (This data is the same for all machines)

These compensated data are selected by select signals from the CPU.

To SRAM, the designated data are output to ROM 2 depending on the address input from the BSS chip.

At ROM 2, 8-bit data sent from the A/D converter are taken into the lower address, the 8-bit compensated data sent from SRAM are taken into the upper address, and BASIS bit compensation and main scanning direction compensation are carried out in accordance with the conversion table stored into ROM 2.

The CPU, in accordance with the lens used (the position of light intensity adjustment dial), selects compensated data in PROM, and by combining the data with the ROM 1 compensated data, creates data for executing compensation, and stores the data in SRAM connected to BSS chip (bit compensation and shading compensation for the main scanning direction are carried out at the same time).

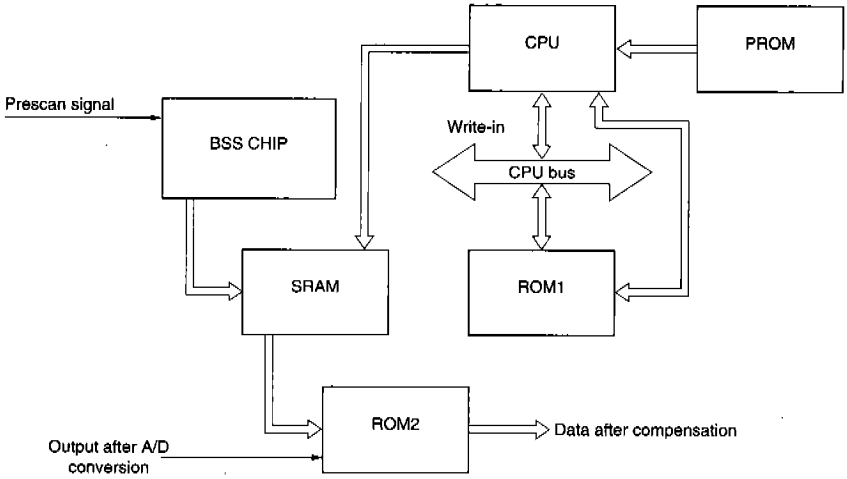

Fig. 3-26

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If we let the data after compensation be A (x, y),

$$A(x, y) = \underbrace{D(x, y)}_{\text{Out put from BASIS}} \times \underbrace{\frac{255}{B(x)}}_{\text{Bit compensation}} \times \underbrace{\frac{255}{H(x)}}_{\text{Main scan compensation}} = D(x, y) \times \frac{255}{BH(x)}$$

Compensated ROM2

D. AE Processing Circuit

Figure 3-28 shows the block diagram of the AE processing circuit.

As explained in Chapter 2, the AE measurement area is 60% of print paper, and at the central pat of the paper.

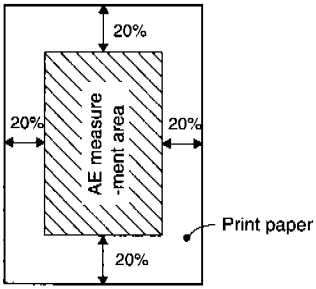

Fig. 3-27

For AE data sampling, the DMA transfer function of the BSS chip is used. The BSS chips has a function of adding the image data of the set number of picture elements after bit and shading compensation from the set horizontal scanning position. The CPU will turn the DMA transfer function of the BSS chip ON when the scanner reaches the AE measurement area at the time of prescanning. In this results, the Image data after sampling and added transmit into DRAM. The CPU will change the set value of the sampling start position in every line, and thus the sampling position will shift obliquely away from the AE measurement area in every line. At the same time, the CPU will change the gain by a factor of 1 and 5 in every line by switching the channels (1 ch and 2 ch) of the analog IC via the BSS chip.

Since the DMA-transferred data is the one to which addition has been made, the CPU conducts a division operation in accordance with the number of picture elements added to find the average value.

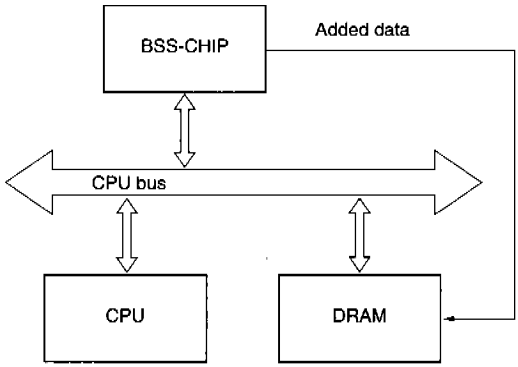

Fig. 3-28

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E. Lens Magnification Ratio Detecting Circuit (MS500 only)

1. Outline

Figure 3-29 shows an outline of the lens magnification ratio detecting circuit.

The microprocessor of the DC controller PCB detects the type and magnification ratio of the zoom lens from the resistance value of the magnification ratio-setting PCB in the zoom lens (the type of zoom lens is detected by the value of the offset resistance), and executes the following controls.

- **Condenser lens position adjustment**
  Automatically adjust the position of the condenser lens in accordance with each magnification ratio and reduces density unevenness. (MS400 is manual)
- **Memory zoom function**
  Zooming is done by one touch to the magnification ratio that was memorize in advance.

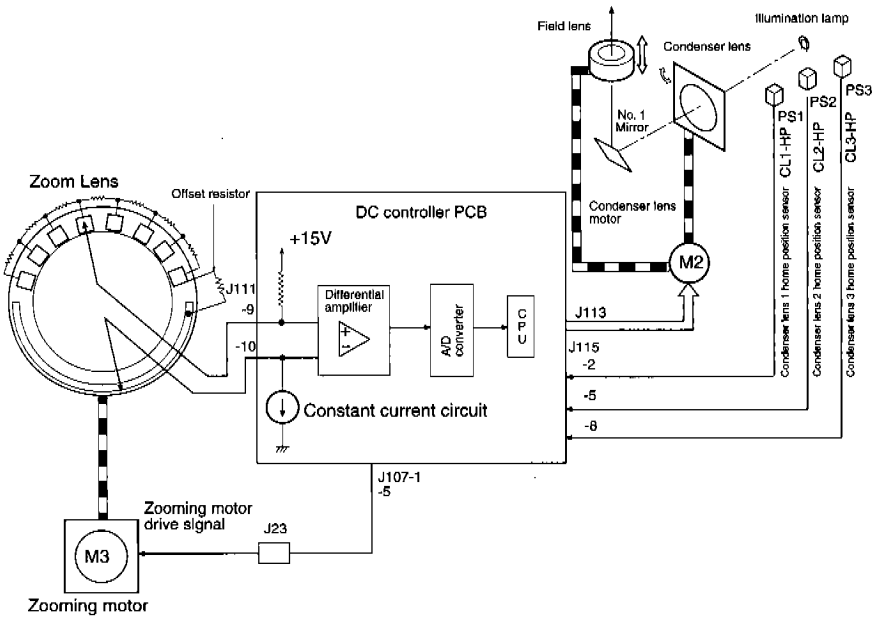

Fig. 3-29

2. Operation

A magnification ratio-setting PCB and contact brushes are located inside the zoom lens, and the position that the PCB contacts varies with the rotation of the zoom lens. This causes the resistance value of the output contact side to vary.

DC controller PCB, with its constant current circuit, causes a fixed electric current to flow to the resistor of the magnification ratio-setting PCB, amplifies the voltage occurring at both ends of the resistor with a differential amplifier and outputs to the CPU on DC controller PCB.

These signals are converted into digital signals by CPU and CPU executes the following controls accordance with the digital signals.

- **Memory zoom function**
  The DC controller PCB drives the zooming motor (M3) to rotate the zoom lens so that they become the magnification ratio that was memorized in advance.
  When the zoom lens specified by memory zoom is not set, error "ﾋ ﾖ" is displayed. This error can be cleared by either pressing the stop clear key or setting the correct zoom lens.
- **Adjusting the positions of condenser lens and field lens**
  The positions of the condenser lens and the field lens are adjusted based on the set magnification. Refer to page 3-11 for details.

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F. Area Designation Unit (=Framing Unit)

1. Outline

Figure 3-30 shows an outline of the area designation (=Framing) unit.

There are four cursors, two vertical and two horizontal, on the screen. The location of these cursors is detected by an area designation PCB provided behind the frame of the screen and output to the DC controller PCB.

These location signals are processed into digital data by the A/D converter in the DC controller PCB.

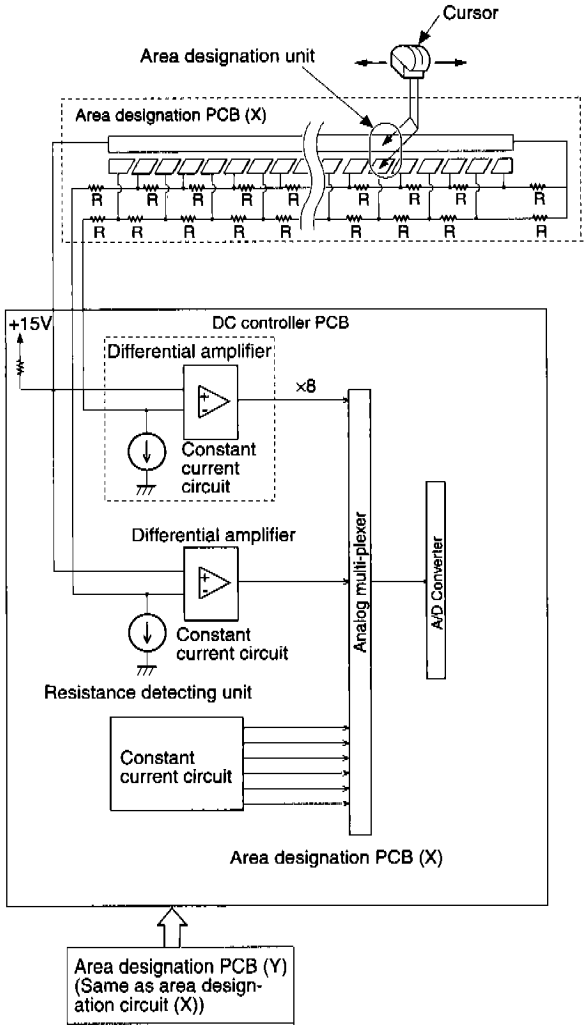

Fig. 3-30

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2. Operation

The area designation unit is composed of contact brushes and position detection unit.

The position detection units are made so that they detect changes in the position of the cursors as changes in resistance.

The position detection unit of each cursor is divided into a common contact section and a position-detecting contact section. Contacts connected to separate resistance detection circuits are arranged alternately in the position-detecting contact section.

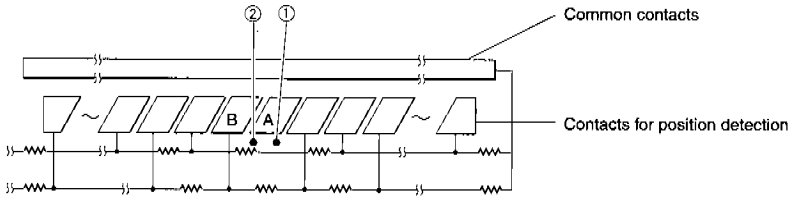
When the cursor moves, its position is determined by the change in resistance caused by the contact brush attached to the common contact and the position-detecting contact.

By having the contacts arranged alternately, when the contact brush of the cursor is at one of the contacts, the position of the cursor is detected only by one position-detecting contacts.

When the contact brush is around the mid point of both contacts, because the contacts are diamond-shaped, the position is detected by the contact brush shorting two position-detecting contacts.

Each resistance detection circuit on the DC controller PCB lets a constant current flow to the resistors of the position-detecting section, amplifies the voltage that is generated at the time with a differential amplifier and outputs the amplified signal to the CPU.

The CPU, after converting the data output from the resistance detection circuit to digital data with the A/D converter, the data is changed to trimming data of 2 mm pitch. Based on this trimming data, trimming is performed after processing the image data on the RAM.



- When the contact brush is in position ①, the position is detected with contact for position detection A only.
- When the contact brush is in position ②, the position is detected with contact for position detection A and B.

Fig. 3-31

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G. Keyboard Circuit

1. Outline

The keyboard switch and LED detect and light up by the CPU on the DC controller PCB.

There are 22 key switches and 24 LEDs on the keyboard operation panel.

2. Circuit explanations

Figure 3-32 shows a block diagram of the keyboard circuit.

The keys are connected in a matrix form. The fixed pulse is output to the key switches from the CPU. The signal is input to the CPU depending on which key is pressed.

The LED lit signal output to LED from the CPU.

DFT0 - DFT4 becomes a high "H" signal. LED SEG0 - LED SEG11 become a low "L" signal. From this, the LEDs light.

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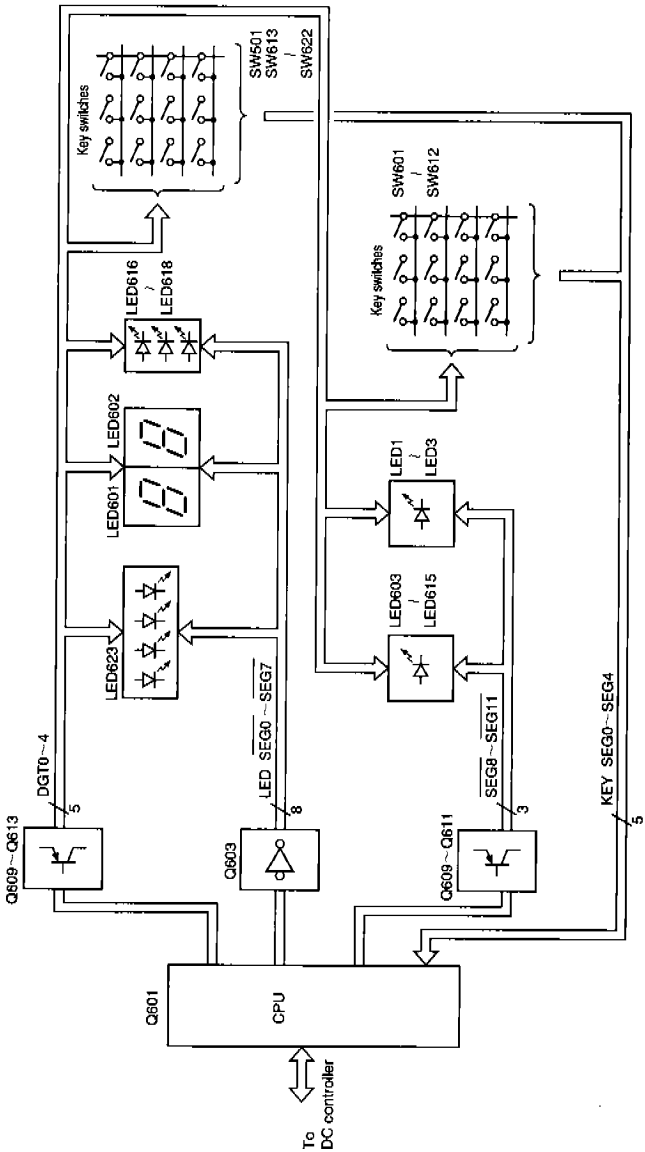

Fig. 3-32

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VI. INTERFACE

A. Outline

This machine has two kinds of interface shown in Fig. 3-33.

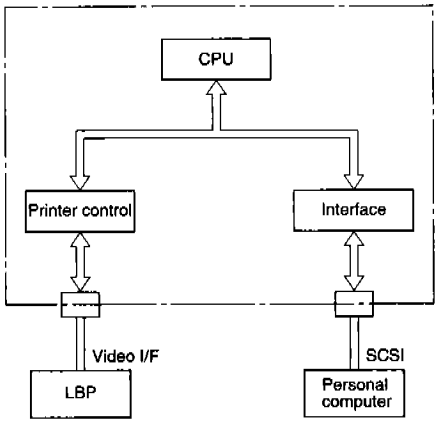

Fig. 3-33

Video I/F communicates with the LBP for the image output.

SCSI Interface communicates with personal computer.

1. Outline of Interfaces

When data is transmitted from this machine to an external device, it passes through an interface. The cable used then is called an interface cable, and the cable connector between this machine and the external device is called an interface connector.

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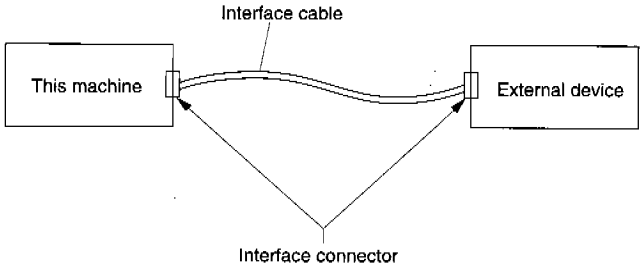

Fig. 3-34

Data is transmitted between this machine and an external device via this interface cable. A set of rules is necessary to transmit data between these two different kinds of hardware.

This set of rules comprises a standard which covers the meaning and transmission procedure of the signals (data and control signals) to be transmitted (protocol: communications rules), and also the hardware. It is necessary for both sides to conform to the same standard.

Interfaces can be broadly divided into parallel interfaces and serial interfaces.

A commonly used parallel interface is the Centronics interface. Other parallel interfaces include GPIB and SCSI.

While, serial interfaces include RS232C, RS422, RS499 and the TTY interface.

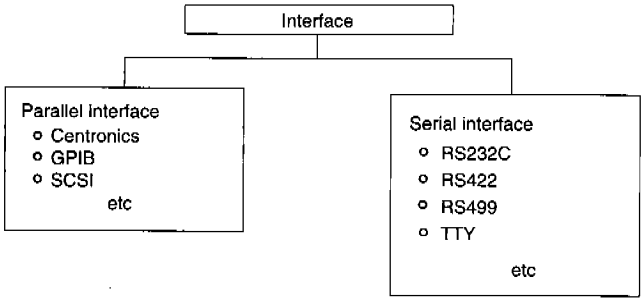

Fig. 3-35

2. Parallel interfaces

When sending parallel data, one byte (1 character) of data can be sent at one time.

A dedicated line is assigned to each bit, and the bits are sent in parallel with each other.

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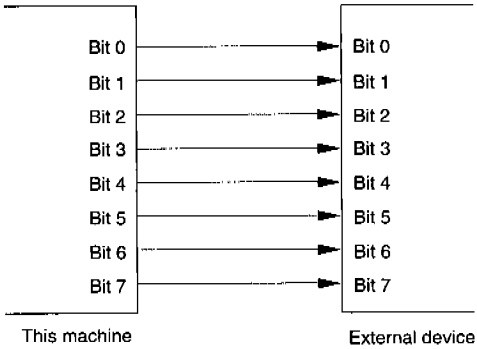

Fig. 3-36

This parallel data is not suitable for transmission over long distances. Generally, the shorter the line, the faster the data can be transmitted.

Note: When parallel data is sent over a long distance, radio frequency interference (RFI) causes a problem, and the data signals themselves become very weak during transmission.

Parallel interfaces include the Centronics interface, GPIB(Note), and SCSI. Of these, GPIB and SCSI have too many functions to make them suitable as a printer interface, hence they are not commonly used.

Note: GPIB (General Purpose Interface Bus) is an interface bus specification standardized as IEEE-488-1975 by IEEE (The Institute of Electrical and Electronics Engineerings).

Because of this standard number, GPIB is sometimes referred to as IEEE488. Table 3-3 shows the maximum ratings of GPIB.

Item	Maximum Value
Total length of cable	20 m
Cable length between devices	5 m
Transmission speed	1 Mbyte/sec
Number of units connected	15 sets

Table 3-3

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3. Serial Interfaces

In serial data transmission, one byte of data is transmitted using one signal line per one bit at a time. Figure 3-37 shows an example of transmitting two bytes of data.

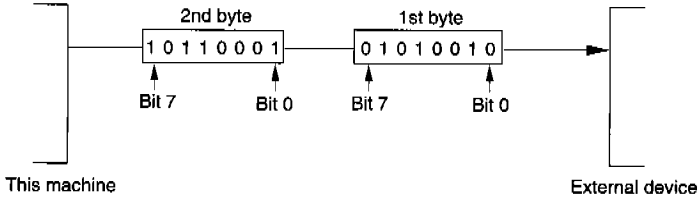

Fig. 3-37

Serial data transmission is not affected by distance, and is most generally used.

Serial interfaces include RS232C, RS422, RS499, TTY interface, etc. High speed features, RS422 and RS499. The TTY interface was formerly used for printer connection using the relay circuit but is no longer in common use.

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B. Video Interface

Figure 3-38 shows the interface signals between this machine and the printer (LBP). The machine and the printer exchange various data by using these interface signals (video interface).

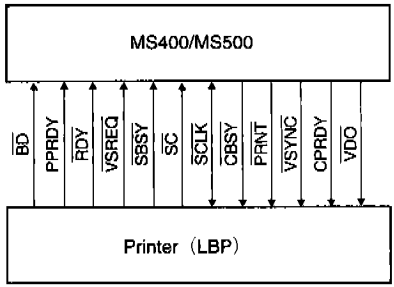

Fig. 3-38

Signal abbreviation	Signal name	Input/output	Meaning
BD	Beam Detection	Input	This signal is used as the horizontal synchronizing signal when the machine is sending video data to the printer. The machine synchronizes with the signal sent from the printer and sends video signals of the main scanning direction of the image signals one line at a time to the printer.
PPRDY	Printer Power ReaDY	Input	This signal indicates that the microprocessor of the printer has finished initial reset and is in a state in which it is able to receive and send SC signals between the computer and the printer.
RDY	ReaDY	Input	Becomes "L" when all the conditions required to make the printer capable of printing exist.
VSREQ	VSyinc REQuest	Input	Becomes "L" when the printer becomes ready to accept video signals (image signals) and requests that vertical synchronizing signals (VSYNC) to receive video signals be sent.
SBSY	Status BuSY	Input	This is the signal output by the printer when it is occupying the SC signal line and SCLK signals for sending out status signals to the machine via the SC signal line. Becomes "L" when the signal is outputing.

Table 3-4

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Signal abbreviation	Signal name	Input/output	Meaning
$\overline{SC}$	Status Command	Input	The printer receives a command from the machine via this status command ($\overline{SC}$) line and returns the status. This signal uses the serial clock (SCLK) to take in signals with encoded 8-bit unit serial signals.
$\overline{SCLK}$	Serial CLocK	Input/output	This signal is used as the synchronized pulse signal when converting the serial signals on the status command ($\overline{SC}$) line to parallel signals. When the printer outputs its status, the signal is output from the printer side and when the machine outputs its command, the signal is output from the machine.
$\overline{CBSY}$	Command BuSY	Output	This indicates that the machine is outputting serial signals via the status command ($\overline{SC}$) line. During outputting the signal becomes "L".
$\overline{PRNT}$	PRiNT	Output	When this signal becomes "L" with the feed paper signal from the machine, the printer feeds paper.
$\overline{VSYNC}$	Vertical SYNC	Output	This is the vertical synchronizing signal sent to the printer and is the sub scanning direction video block signal.
$\overline{CPRDY}$	Controller Power ReaDY	Output	This signal indicates that power has been supplied to the machine, that the machine's initializing process is finished, and that the machine is ready to send and receive status command ($\overline{SC}$) signals between the machine and the printer.
$\overline{VDO}$	ViDeO	Output	This is the signal that indicates the image data that the printer should print, and the printer prints the valid area of the $\overline{VDO}$ signal black and the invalid area white.

Table 3-4

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When the printer power ready signal (PRTPR) and the status busy signal (SBSY) sent from the printer to the machine become "H", the scanner, by making the command busy signal (CBSY) "L", notifies the printer that it will use the status/command signal (SC). And then, commands can be sent to the printer via the SC line.

For example, if the scanner sends the printer a status/command via the SC line, the printer, after making the status busy signal (SBSY) "L", sends various status (replenishing paper, checking paper feed, etc.) to the scanner via the SC line.

Serial clock (SCLK) is used as the sampling pulse to read the serial command sent from the SC line or the status.

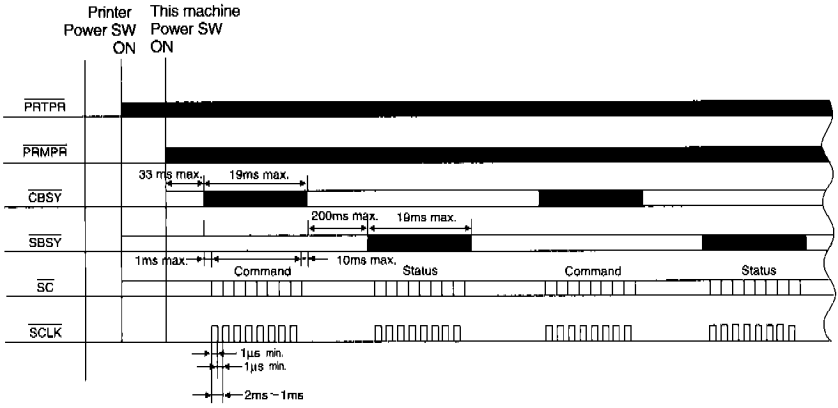

Fig. 3-39

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C. SCSI Interface

1. Outline

SCSI is an abbreviation for Small Computer System Interface. It is a standard interface between a computer and a peripheral device.

An SCSI can be connected almost regardless of the kind of devices connected to the SCSI bus.

An SCSI permits a plurality of peripheral devices of as many as seven sets to be connected to the logical bus.

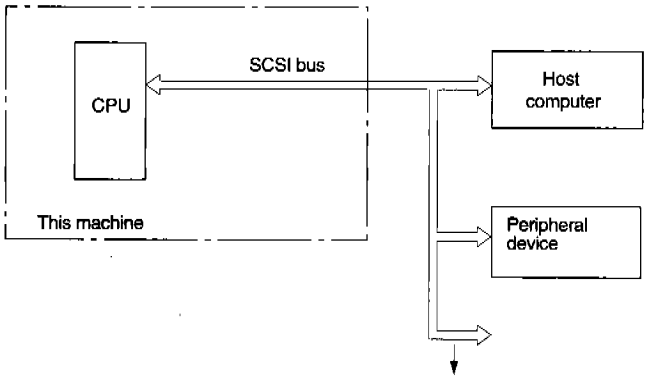

Fig. 3-40

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2. Main signals used for data transmission

The main signals on the SCSI bus are shown in Table 3-5.

The SCSI bus consists of a total of 18 signal lines which consist of data signals (one byte + parity bits = nine signals) and control signals (nine signals).

Pin No.	Signal name	Input/output at CPU side	Meaning
26-34	DB7 - 0, DBP (Data Bus)	Input/output	This is a bidirectional data bus consisting of one byte of data and an odd parity bit. This data bus is used to transmit commands, data, statuses and messages in the data transmission phase. In the arbitration phase, it is also used to output an SCSI ID for judging the priority sequence of the right to use a bus. In addition, in the selection or re-selection phase, the SCSI ID for identifying the initiator and target is sent out.
43	BSY (BuSY)	Input/output	This signal indicates that the SCSI bus is being used. Also, in the arbitration phase, it indicates a request for the right to use the bus.
47	SEL (SELect)	Input/output	This signal indicates that the initiator selected the target (selection phase) or that the target re-selected the initiator (re-selection phase). Also, in the arbitration phase, it indicates that the right to use the bus has been successfully obtained.
48 50 46	C/D (Control/Data) I/O (Input/Output) MSG (MeSsaGe)	Input	The target specifies the kind of data to be transmitted on the data bus according to the particular combination of these three signals. The I/O signal is also used to identify the selection phase and the re-selection phase.
49	REQ (REQuest)	Input	This signal is sent from the target requesting the initiator to transmit data, in the data transmission phase.
44	ACK (ACKnowledge)	Output	This signal is sent from the initiator to the target in response to the REQ signal.
41	ATN (ATeNtion)	Output	This signal indicates that the initiator has a message to be sent to the target.
45	RST (ReSeT)	Input/output	This signal instructs all SCSI devices on the bus to be reset.

Table 3-5

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3. Data Transmission

The data input and output, and the signal name of the connector are shown below.

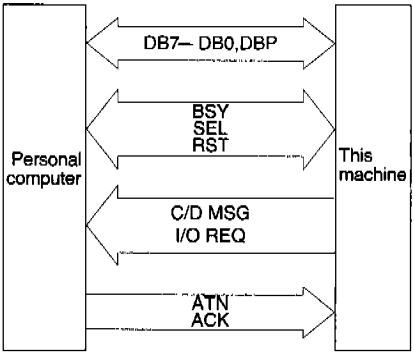

Fig. 3-41

Pin NO.	Signal Name	Remarks
1-12	GND	(Ground)
13	Open	(Non-connection)
14-25	GND	(Ground)
26	-DB0	(Data Bit 0)
27	-DB1	(Data Bit 1)
28	-DB2	(Data Bit 2)
29	-DB3	(Data Bit 3)
30	-DB4	(Data Bit 4)
31	-DB5	(Data Bit 5)
32	-DB6	(Data Bit 6)
33	-DB7	(Data Bit 7)
34	-DBP	(Odd Parity Data Bit)
35-37	GND	(Ground)
38	TERMPWR	(Termination Power)
39-40	GND	(Ground)
41	-ATN	(Attention)
42	GND	(Ground)
43	-BSY	(Busy)
44	-ACK	(Acknowledge)
45	-RST	(Reset)

Pin NO.	Signal Name	Remarks
46	-MSG	(Message)
47	-SEL	(Select)
48	-C/D	(Control/Data)
49	-REQ	(Request)
50	-I/O	(Input/Output)

The hyphen "–" in the signal name means a low active signal.

Table 3-6

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4. Control Method

The basic procedure for drive control via the SCSI interface is as shown in Figure 3-42.

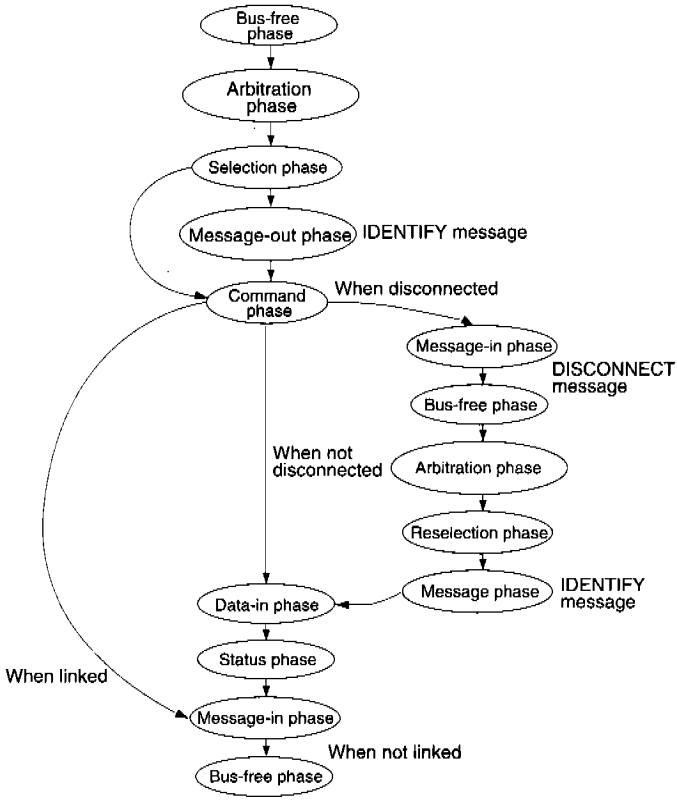

Fig. 3-42

The function of each phase is as shown below.

The state of the SCSI bus during an operation between the initiator and the controller is divided into the following eight phases. The transition of these bus phases ensure that the SCSI bus cannot enter two or more phases at any one time. In a system which has a single initiator and does not use a disconnect/reconnect function, the arbitration phase and re-selection phase can be omitted.

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Name	Function
Bus-free phase	The state in which the SCSI bus is not used by any initiator or target. All signals on the bus are OFF.
Arbitration phase	The arbitration phase is used before the device which is to become the initiator selects the target, and also before the target device that is disconnected from the initiator selects the initiator (re-selection), in order to obtain the right to use the SCSI bus. This phase requires a multi-host environment in which a plurality of initiators exists. The initiator turns ON the BSY signal and simultaneously outputs its own ID bits to the SCSI bus, in order to obtain the right to use the bus. This phase can be omitted in a single initiator environment because no dispute over the bus arises.
Selection phase/re-selection phase	Each of the selection and re-selection phases is used to connect the initiator and the target by software. In the selection phase, when the initiator turns the SEL signal ON, the selection code which specifies the target number to be selected is output to the SCSI bus. Conversely, in the re-selection phase, the target device selects the initiator.
Command phase	In this phase, the initiator sends commands to the target device. The commands are sent as continuous bytes in a fixed form. When a link is specified in the command phase, the system will not return to the Bus-free phase after the status phase and the message input phase that follow, but will enter the command phase instead.
Data phase	This phase is used when data returns after a command that requires the return of data was executed in the command phase, or when data is being read from the disk or written to it. This phase can be either the Data-in phase or the Data-out phase depending on whether the initiator receives data or sends it.
Status phase	In this phase, a status command which indicates the status in which execution of a command was completed is returned. The system sometimes enters the status phase during the actual execution of a command as well.

Table 3-7

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Name	Function
Message phase	This phase is either the Message-out phase when a message is being sent from the initiator to the target device, or the Message-in phase when a message is being sent from the target device to the initiator. A message is generally used for providing notification of the state accompanying a transition phase between the target and the initiator. Messages consist of those that are always sent in a standard sequence, such as an identification, and those that are sent for processing purposes in the event of an error.

Table 3-7

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5. SCSI Bus Conditions

The SCSI bus is provided with two kinds of asynchronous operations (bus conditions), an attention condition and a reset condition, to control the bus phase transition sequence.

The following is a description of these conditions.

• Attention condition

An attention condition is a function used to notify a terget that the initiator has some kind of message. The initiator can generate an attention condition at any time other than during the arbitration or bus free phase. An attention exists while the initiator the maintains the ATN signal true.

A terget that detected the ATN signal moves to the message out phase at the following timing, and receives a message from the initiator.

① If the ATN signal was detected in the command phase, the terget will enter the message out phase immediately after receiving all the command description blocks. The initiator must continue REQ/ACK handshaking until the phase changes.

② If the ATN signal was detected in the data phase, the terget will enter the message out phase immediately after all data has been transmitted. The initiator must continue REQ/ACK handshaking until the phase changes.

③ If the ATN signal was detected in the status phase, the terget will enter the message out phase immediately after initiator receiving the status.

④ If the ATN signal was detected in the message in phase, the terget will enter the message out phase immediately after initiator receiving the present message.

⑤ If the ATN signal was detected in the selection phase, the terget will enter the message out phase immediately after the selection phase.

⑥ If the ATN signal was detected in the re-selection phase, the terget will enter the message out phase immediately after initiator receiving the "Identify message" in the message in phase immediately after the re-selection phase.

The terget continues to implement the message out phase until the ATN signal becomes false. Consequently, the initiator will maintain the ATN signal true, even if the message out phase starts. After the REQ signal corresponding to the prepared message (the final byte message in the case of a message consisting of a plurality of bytes) has been received, the ATN signal must be made false before a reply can be made to the ACK signal. If the ATN signal remains true after the ACK signal reply, the controller will judge that there is a message, maintain the message out phase, and output the REQ signal.

If the terget detected a parity error while receiving a message, it will maintain the message out phase until the ATN signal becomes false, then output the REQ signal without changing the phase. Next, the initiator will reply to this message request, and re-transmit the immediately preceding message. If it is necessary to re-send a plurality of bytes, the initiator will make the ATN signal true before replying to the first ACK signal.

If the terget receives a message normally, it will enter a data transmission phase other than the message phase or the bus free phase in accordance with the provisions of the message.

• Reset condition

A reset condition is a function used to interrupt the operation of the SCSI device or to disconnect all SCSI devices from the bus. The reset condition can be generated for any SCSI device whatever by making the RST signal true for at least 25 µsec (Reset Hold Time). All SCSI devices must stop the drive to all signals other than the RST signal and release the bus within 800 nsec (Bus Clear Delay). The SCSI bus always enters the bus free phase after a reset condition.

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VII.POWER SUPPLY

A. Outline

AC power is supplied to the DC power PCB by turning on the power supply switch (SW1).

The types of power output from the DC power PCB are +24V DC, ±15V DC, +5V DC and variable voltage (+10 to +20V: for illumination lamp use).

Also, since turning off the power supply switch causes the power supply to the DC power PCB to be cut off, the machine is equipped with a lithium battery as a backup for the data in the RAM in the DC controller PCB.

B. Electric Circuit Protection Function

The circuit system of the DC power supply is the switching regulator method.

If the load becomes a short circuit due to some reason and an excess current flows through the circuit, the protection function is activated and output stops.

When the output stops it can be restored by eliminating the cause of the short circuit.

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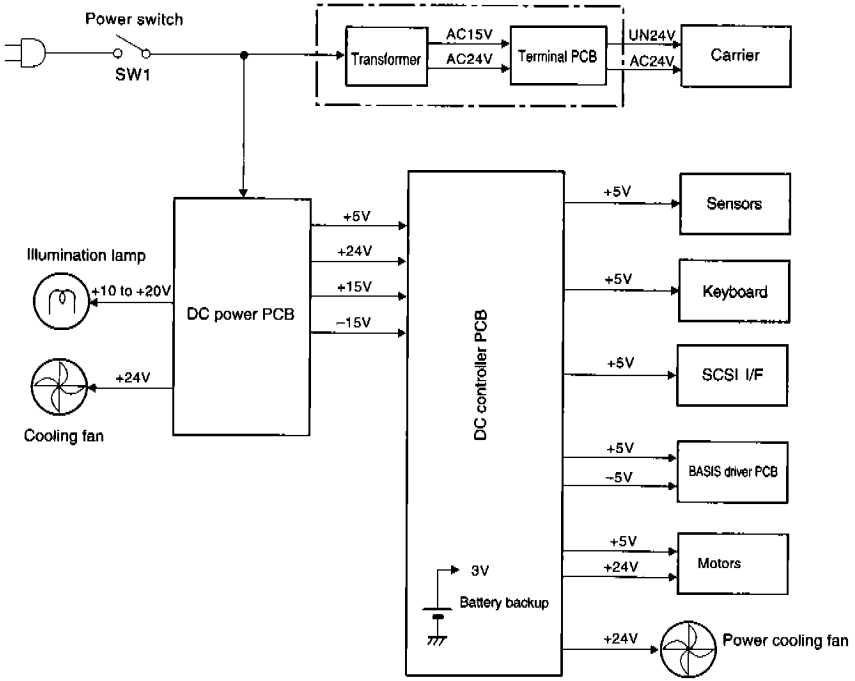

Fig. 3-43

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VIII. LAYOUT OF ELECTRICAL COMPONENTS

A. Sensors

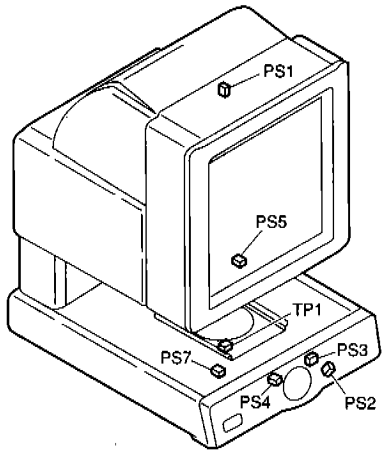

Fig. 3-44

Symbol	Name	Code	Function
	Photo interrupter	PS1	Scanner home position detection
		PS2	Condenser lens home position 1 detection
		PS3	Condenser lens home position 2 detection (MS400 only)
		PS4	Condenser lens home position 3 detection (MS 400 only)
		PS5	Prism lens home position detection (MS500 only)
		PS7	Illumination lamp lighting detection
	Thermo-protector	TP1	Cutting off applied voltage when temperature of illumination section rises abnormally high.

Table 3-8

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B. Switches/Lamps

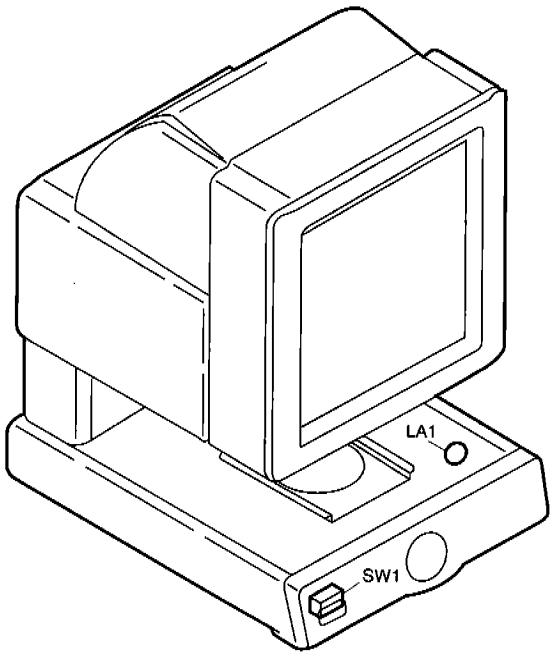

Fig. 3-45

Symbol	Name	Code	Function
	Microswitch	SW1	For power ON/OFF
	Illumination lamp	LA1	For film illumination

Table 3-9

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C. Fan/Motors

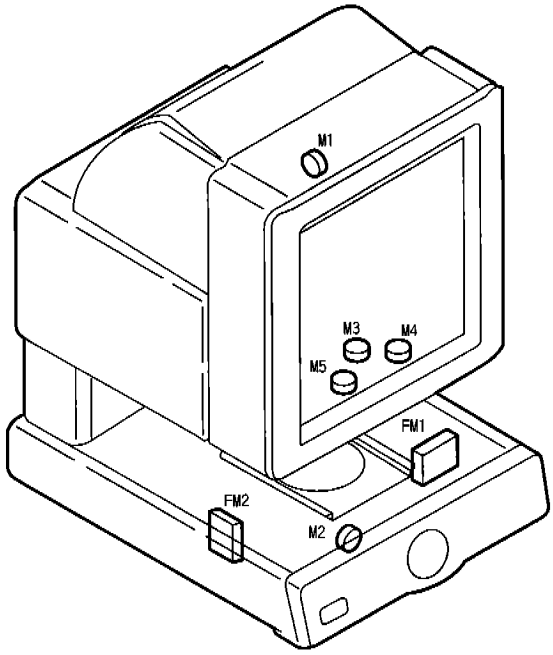

Fig. 3-46

Symbol	Name	Code	Function
(M)	Motor	M1	For scanner drive
		M2	For condenser lens drive (MS500 only)
		M3	For lens drive (zooming) (MS500 only)
		M4	For prism drive (rotation) (MS500 only)
		M5	For lens drive (focusing) (MS500 only)
	Fan	FM1	For illumination lamp cooling
		FM2	For DC power PCB assembly cooling

Table 3-10

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D. PCBs

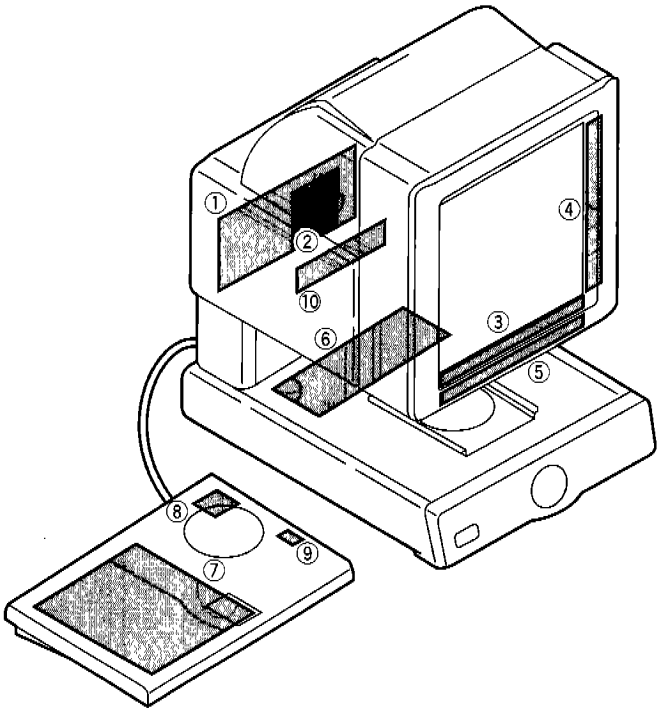

Fig. 3-47

Code	Name	Function
①	DC controller PCB	For sequence control and transmission with external devices
②	SCSI driver PCB	For interface with external SCSI devices (option)
③	Area X PCB	For area designation (X direction) (option)
④	Area Y PCB	For area designation (Y direction) (option)
⑤	Control panel PCB	For operation and display
⑥	DC power supply PCB	DC power stableness
⑦	Keyboard PCB	For keyboard input and display (MS500 only)
⑧	LED PCB	For image selection display (MS500 only)
⑨	Select PCB	For image adjustment selection (MS500 only)
⑩	BASIS driver PCB	For BASIS drive

Table 3-11

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IX. LIST OF VARIABLE RESISTORS (VR), LEDS AND CHECK PINS FOR EACH PCB

Variable resistors (VRs), LEDs and check pins that are necessary for servicing the machine at the customers premises are described below.

VRs and check pins not listed in the table should be adjusted at the factory only. Special tools and measuring instruments are required to perform adjustments and checks using these VRs and check pins, and often a high degree of accuracy is demanded. Do not touch these VRs and check pins.

Note:

1 Some LEDs pass a small amount of current even in the normal (unit) state, causing them to glow weakly even when they are supposed to be extinguished.
2 VRs that may be adjusted at the customer's premises..... ●
3 VRs that must not be adjusted at the customer's premises..... ⊘

A. DC Controller PCB

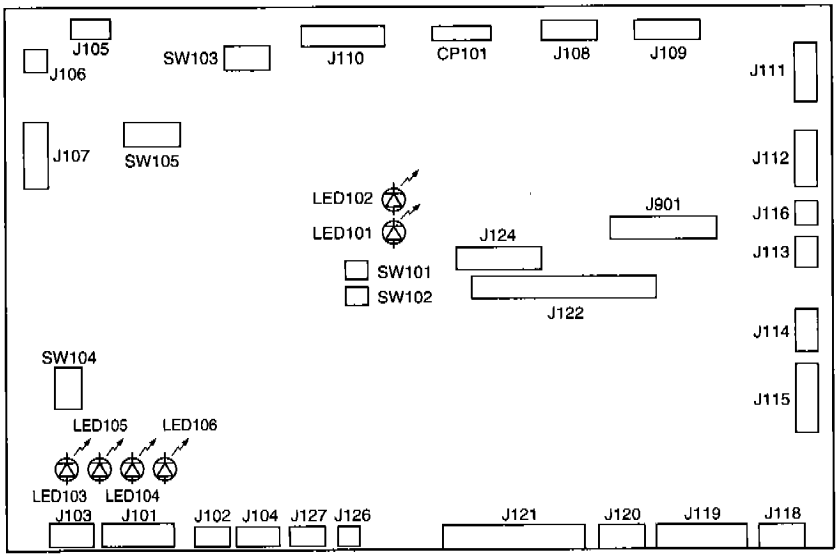


Fig. 3-48

LED No.	Illumination description
LED101	Flashes when CPU normally operates.
LED102	Flashes in service mode
LED103	Lights up when +24 VDC is supplied.
LED104	Lights up when +15 VDC is supplied.
LED105	Lights up when +5 VDC is supplied.
LED106	Lights up when –15 VDC is supplied.

Table 3-12

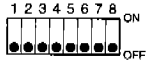
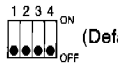
Switch No.	Setting description
SW101	CPU reset switch
SW102	For service mode (Refer to Chapter 7 for details)
SW103	 (Default) • Bit 1 Scanning without LBP with ON • Bit 2 ON when video interface board (option) is used. • Bit 3 For factory setting • Bit 4 ON when FS controller III is used. • Bit 5 - Bit 8 For factory setting
SW104 SW105	 (Default) For factory setting

Table 3-13

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B. BASIS Driver PCB

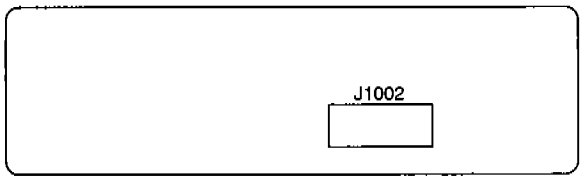

Fig. 3-49

C. CONTROL PANEL PCB

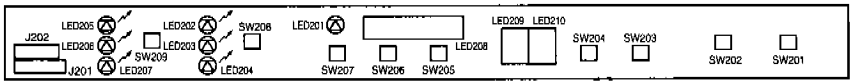

Fig. 3-50

LED No.	Display description
LED201	AE selection LED
LED202	Trimming selection LED
LED203	Border selection LED
LED204	No border selection LED
LED205	N-P print selection LED
LED206	P-P print selection LED
LED207	Automatic N/P judgment selection LED
LED208	Print density/sharpness adjustment LED
LED209 LED210	Print page/error code LED

Table 3-14

Switch No.	Setting description
SW201	Print start key
SW202	Clear/stop key
SW203	Print page and area designation (increase) key
SW204	Print page and area designation (decrease) key
SW205 SW206	Print density and sharpness adjustment setting key
SW207	AE selection key
SW208	Trimming/Border erasure selection key
SW209	Negative/positive switching key

Table 3-15

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D. Keyboard PCB

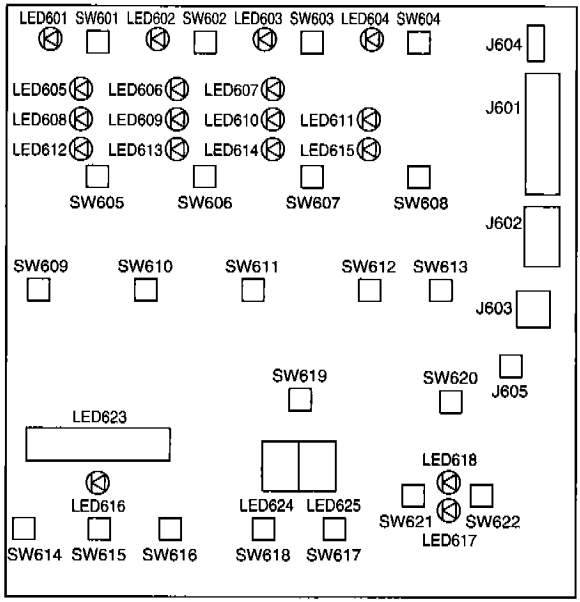

Fig. 3-51

LED No.	Display description
LED601	"Date" print selection display
LED602	"Message" print selection display
LED603	"Picture" mode selection display
LED604	"Sharpness" adjustment mode selection display
LED605	N-P print selection display
LED606	Paper feed tray selection display
LED607	Trimming selection display
LED608	P-P print selection display
LED609	Upper cassette selection display
LED610	No border selection display
LED611	Not used
LED612	Automatic N/P judgment selection display

LED No.	Display description
LED613	Lower cassette selection display
LED614	Border selection display
LED615	Automatic rotation print selection display
LED616	"AE" selection display
LED617 (red) LED618 (green)	Print display
LED623	Print density/sharpness adjustment display
LED624 LED625	Print page/error code display

Table 3-16

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Switch No.	Setting description
SW601	"Date" selection key
SW602	"Message" selection key
SW603	"Picture" selection key
SW604	"Sharpness" selection key
SW605	Negative/positive switch key
SW606	Cassette selection key
SW607	Trimming/border erasure selection key
SW608	Rotation key
SW609	"M1" selection key
SW610	"M2" selection key
SW611	"M3" selection key

Switch No.	Setting description
SW612	Rotation (right rotation) key
SW613	Rotation (left rotation) key
SW614	Print density/sharpness
SW616	adjustment setting key
SW615	AE selection key
SW617	Print page setting (increase) key
SW618	Print page setting (decrease) key
SW619	Reset key
SW620	Clear/stop key
SW621	Print start key
SW622	

Table 3-17

E. LED PCB

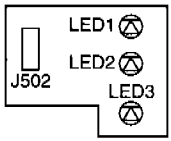

Fig. 3-52

LED No.	Display description
LED1	Zooming selection LED
LED2	Focus selection LED
LED3	Rotation selection LED

Table 3-18

F. SCSI Driver PCB

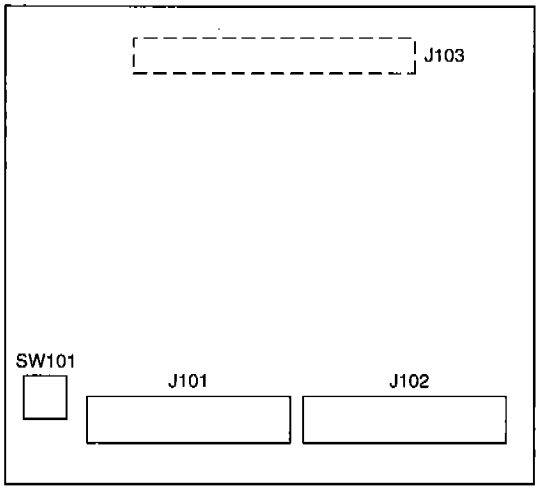

Fig. 3-53

Switch No.	Setting description
SW101	Setting ID for SCSI

Table 3-19

G. Area X and Area Y PCB

Fig. 3-54

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I. EXTERNALS

A. Covers

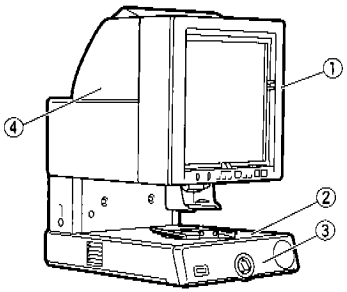


Fig. 4-101

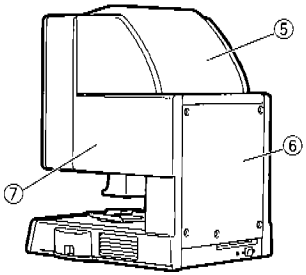


Fig. 4-102

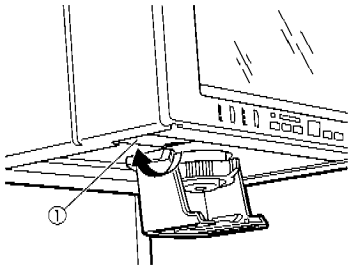
①	Screen cover	(0) [2]
②	Table cover	(0) [0]
③	Lower front cover	(0) [2]
④	Left cover	(0) [6]
⑤	Upper cover	(0) [0]
⑥	Rear cover	(5) [0]
⑦	Right cover	(2) [4]

Note: Numbers in ( ) indicate the number of screws.
Numbers in [ ] indicate the number of mounting hooks.

Remove the cover of the parts in the machine to which access must be gained to clean and inspect internal parts of the machine, according to the following procedure. Description is not given for covers which can be removed by simply unscrewing the mounting screws.

1. Screen cover

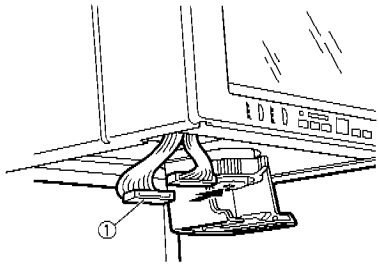
a. Remove the blind plate ①.



① Blind plate

Fig. 4-103

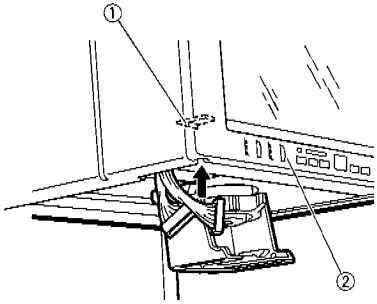
b. Pull out the cable and disconnect the connector (1pc.) ①. (2 pcs. on the machines with the area designation unit)



① Connector

Fig. 4-104

c. Unhook the two hooks (one hook each on right/left) ①, remove the screen cover ②.

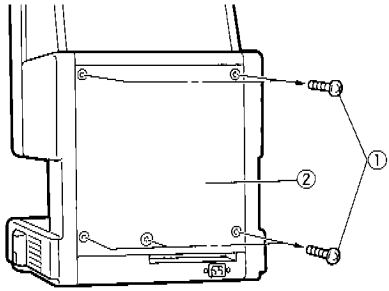


① Hook
② Screen cover

Fig. 4-105

2. Rear cover

a. Unscrew the five screws ① and remove the rear cover ②.

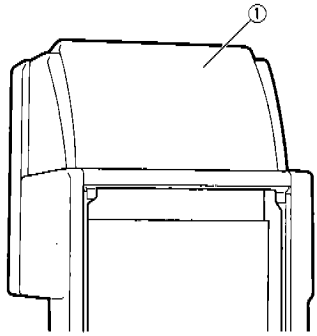


① Screw
② Rear cover

Fig. 4-106

3. Upper cover

a. Remove the rear cover. (5 screws)
b. Remove the upper cover ①.



① Upper cover

Fig. 4-107

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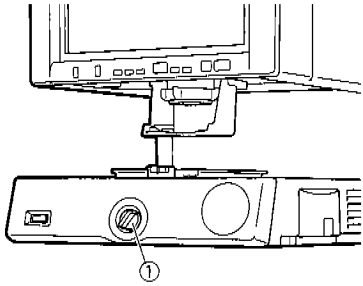
4. Lower front cover

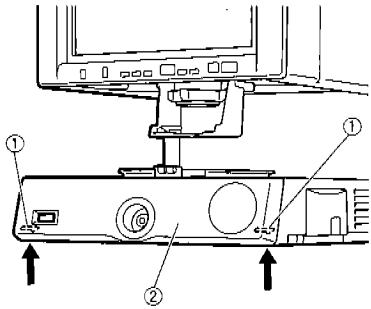
a. For MS400 only
Remove the light intensity adjustment dial ①.



① Light intensity adjustment dial.

Fig. 4-108

b. Unhook the two hooks ① and lower front cover ②.

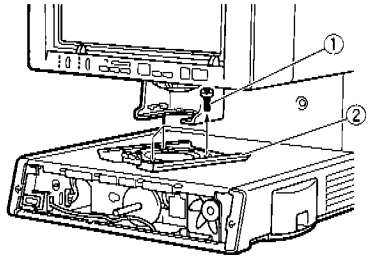


① Hook
② Lower front cover

Fig. 4-109

5. Table cover

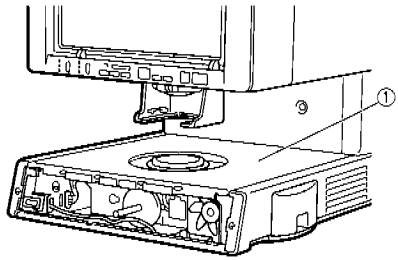
a. Remove the lower front cover. (2 hooks)
b. Remove the lens.
c. Unscrew the three hex screws ① and remove the carrier mount ②.



① Hex screws
② Carrier mount

Fig. 4-110

d. Remove the table cover ①.



① Table cover

Fig. 4-111

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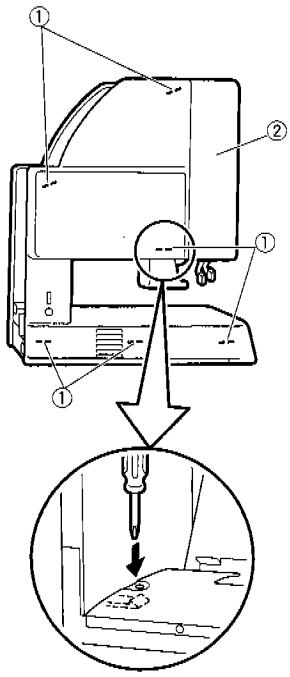
6. Left cover

a. Remove the screen cover. (2 hooks)
b. Remove the rear cover. (5 screws)
c. Remove the upper cover.
d. Remove the lower front cover. (2 hooks)
e. Remove the lens.
f. Remove the carrier mount. (3 hex screws)
g. Remove the table cover.
h. Unhook the six hooks ① and remove the left cover ②.

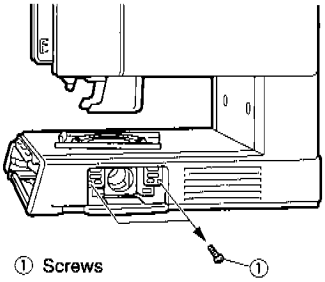


① Hooks
② Left cover

Fig. 4-112

7. Right cover

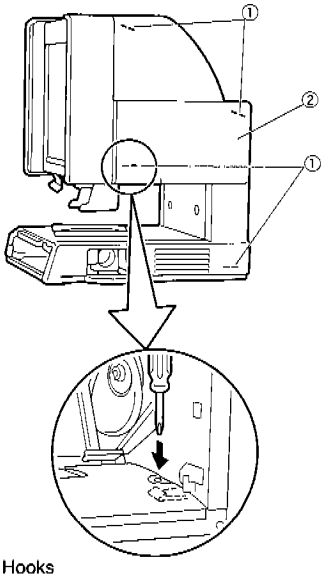
a. Remove the screen cover. (2 hooks)
b. Remove the rear cover. (5 screws)
c. Remove the upper cover.
d. Remove the lower front cover. (2 hooks)
e. Remove the illumination unit.
f. Unscrew the two screws ①.



① Screws

Fig. 4-113

g. Unhook the four hooks ① and remove the right cover ②.



① Hooks
② Right cover

Fig. 4-114

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B. Fan

1. Outline

This machine is equipped with the two fan motors, which are used for cooling the machine.

The main function of each fan are as follows:

Illumination lamp cooing fan (FM1):

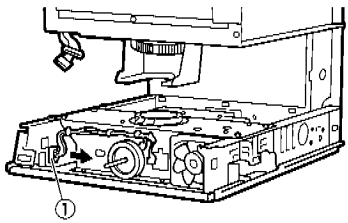
Cools the illumination lamp.

Power supply cooling fan (FM2):

Cools the DC power supply PCB.

2. Illumination lamp cooling fan (FM1)

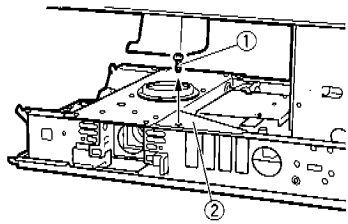
a. Remove the screen cover. (2 hooks)
b. Remove the rear cover. (5 screws)
c. Remove the upper cover.
d. Remove the lower front cover. (2 hooks)
e. Remove the lens.
f. Remove the carrier mount. (3 hex screws)
g. Remove the table cover.
h. Remove the left cover. (6 hooks)
i. Remove the illumination unit.
j. Remove the right cover. (2 screws and 4 hooks)
k. Disconnect the connector (1pc.) ①. (2pcs. for MS500)



① Connector

Fig. 4-115

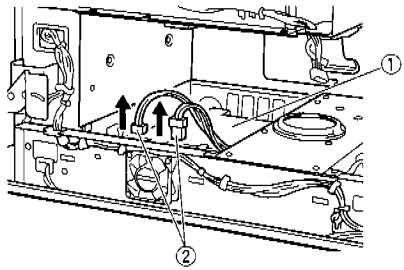
l. Disconnect the screw ① and remove the fan duct ②.



① Screw
② Fan duct

Fig. 4-116

m. Disconnect the two connectors ② (J802 and J806) on the power supply unit ①.



① Power supply unit
② Connectors

Fig. 4-117

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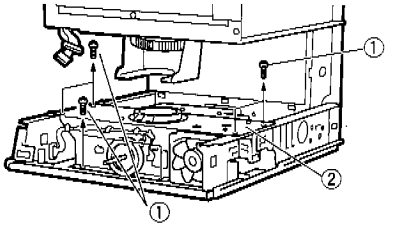
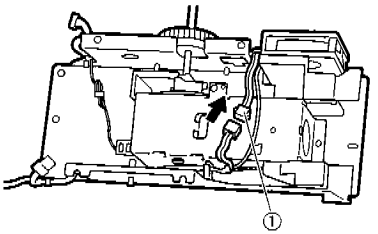
n. Unscrew the six screws ① and remove the light source unit ②.



① Screws
② Light source unit

Fig. 4-118

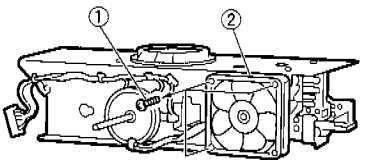
o. Disconnect the connector ①.



① Connector

Fig. 4-119

p. Unscrew the three screws ① and remove the illumination lamp cooling fan ②.

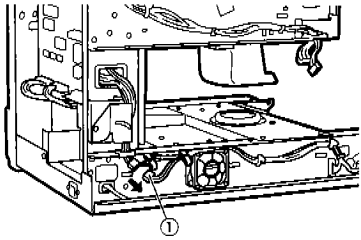


① Screws
② Illumination lamp cooling fan

Fig. 4-120

3. Power cooling fan (FM2)

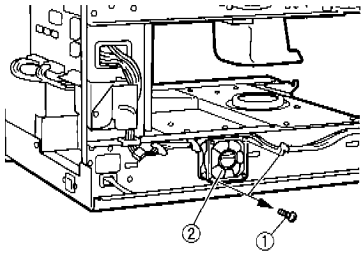
a. Remove the screen cover. (2 hooks)
b. Remove the rear cover. (5 screws)
c. Remove the upper cover.
d. Remove the lower front cover. (2 hooks)
e. Remove the lens.
f. Remove the carrier mount. (3 hex screws)
g. Remove the table cover.
h. Remove the left cover. (6 hooks)
i. Remove the connector ①.



① Connector

Fig. 4-121

j. Unscrew the two screws ① and remove the power supply cooling fan (FM2) ②.



① Screws
② Power cooling fan

Fig. 4-122

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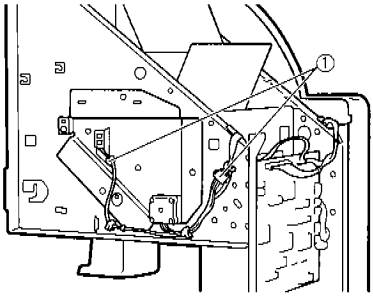
II. DRIVING ASSEMBLY

A. Scanner Motor Unit

a. Enter the service mode and set the address to "1".
b. Set the data to "F0" and press the AE key. (Scanner service position mode)
c. Exit from the service mode and turn the power off.
d. Remove the screen cover. (2 hooks)
e. Remove the rear cover (5 screws)
f. Remove the upper cover.
g. Remove the lower front cover. (2 hooks)
h. Remove the illumination unit.
i. Remove the right cover (2 screws and 4 hooks)
j. Disconnect the two connectors ①.

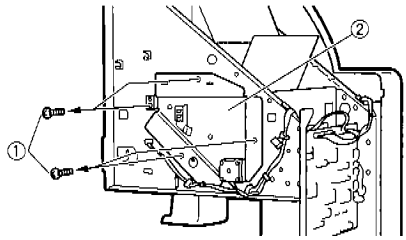


① Connectors

Fig. 4-201

k. Unscrew the four screws ① and remove the scanner drive unit ②.

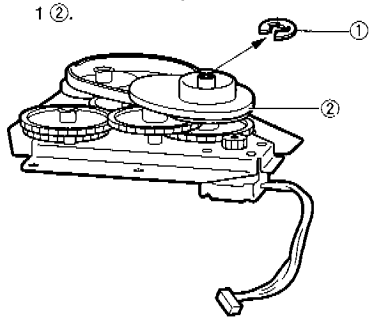
> Note: If the face of cam has a scratch, the image is influenced. So take care of removeing and reassembling.



① Screws
② Scanner drive unit

Fig. 4-202

l. Remove the E-ring ① and take out the cam 1 ②.



① E-ring
② Cam 1

Fig. 4-203

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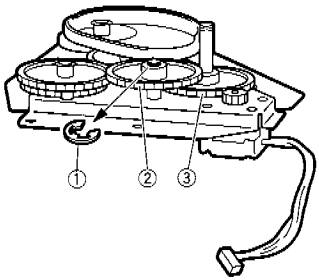
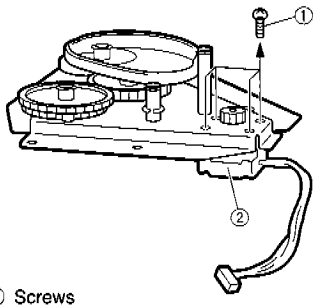
m. Remove the E-ring ① and remove the gear 1 ② and gear 2 ③.



① E-ring
② Gear 1
③ Gear 2

Fig. 4-204

n. Unscrew the four screws ① and remove the scanner motor (M1) ②.



① Screws
② Scanner motor

Fig. 4-205

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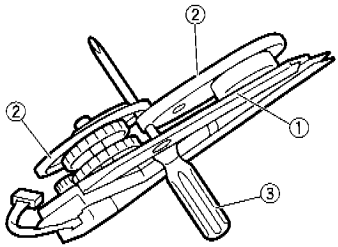
B. Adjusting the Scanner Drive Unit Mounting Position

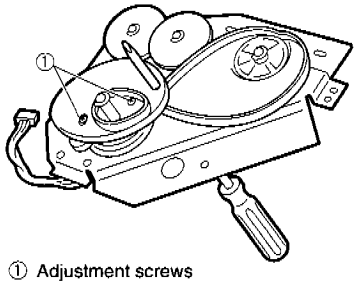
a. Insert the screwdriver ③ of the diameter the same in diameter as the hole on the mounting plate ①. Likewise, insert the same screwdriver into the hole on the cam ② to penetrate.



① Mounting plate
② Cams
③ Screwdriver

Fig. 4-206

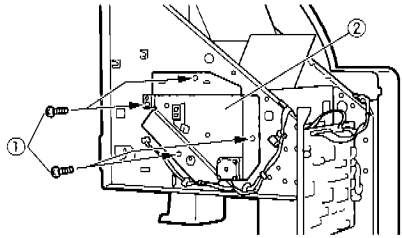
b. Fix the two adjustment screws ①.



① Adjustment screws

Fig. 4-207

c. Mount the scanner drive unit ② with four screws ① in such a manner that the rollers with scanner mirror and BASIS unit are on the cams.
Do not scratch or otherwise damage the face of the cam.



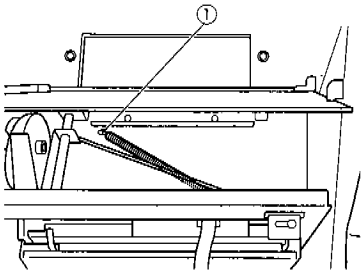
① Screws
② Scanner drive unit

Fig. 4-208

III. OPTICAL PATH

A. Basis Unit

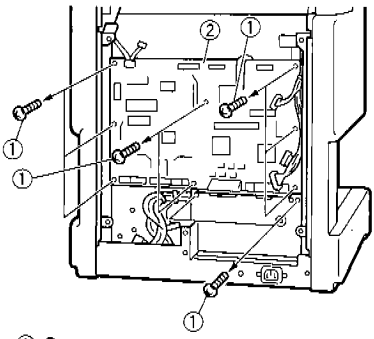
a. Remove the rear cover (5 screws)
b. Remove the upper cover.
c. Unhook the coil spring hook ① fitted to the inside of the main body.



① Coil spring hook

Fig. 4-301

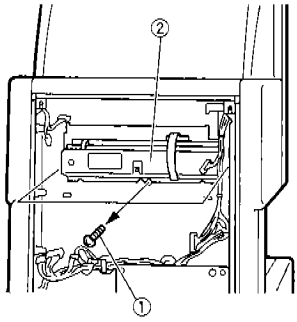
d. Disconnect the all connectors on the DC controller PCB.
e. Unscrew the ten screws ① and remove the DC controller PCB ②.



① Screws
② DC controller PCB

Fig. 4-302

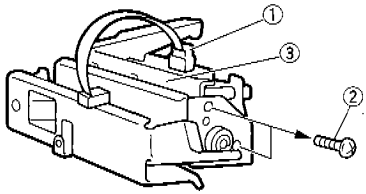
f. Unscrew the three screws ① and remove the BASIS drive unit ②.



① Screws
② BASIS drive unit

Fig. 4-303

g. Remove the cable ①, unscrew the two screws ②, and remove the BASIS unit ③.



① Cable
② Screws
③ BASIS unit

Fig. 4-304

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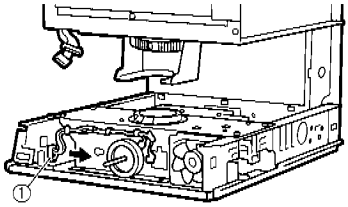
B. Light Source Unit

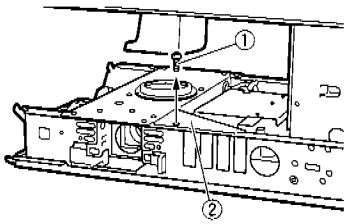
a. Remove the screen cover. (2 hooks)
b. Remove the rear cover (5 screws)
c. Remove the upper cover.
d. Remove the lower front cover. (2 hooks)
e. Remove the lens.
f. Remove the carrier mount. (3 hex screws)
g. Remove the table cover.
h. Remove the left cover. (6 hooks)
i. Remove the illumination unit.
j. Remove the right cover. (2 screws and 4 hooks)
k. Disconnect the connector (1pc.) ①. (2pcs. for MS500)



① Connector

Fig. 4-305

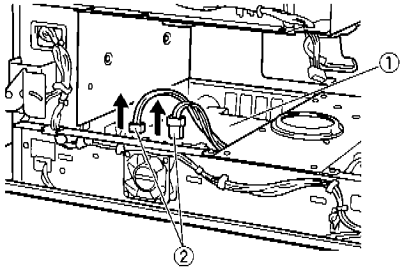
l. Disconnect the screw ① and remove the fan duct ②.



① Screw
② Fan duct

Fig. 4-306

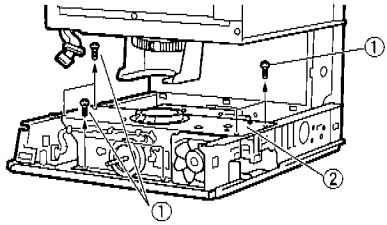
m. Disconnect the two connectors ② (J802 and J806) on the power supply unit ①.



① Power supply unit
② Connectors

Fig. 4-307

n. Unscrew the six screws ① and remove the light source unit ②.



① Screws
② light source unit

Fig. 4-308

Note: Adjust the D cut mark and the drive shaft shape. (MS400 only)

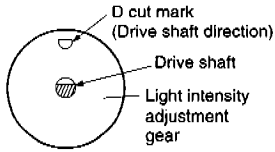


Fig. 4-309

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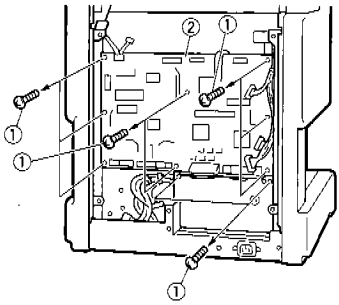
IV. ELECTRICITY

A. DC Controller PCB

a. Record all the data in the service mode.
b. Remove the rear cover (5 screws)
c. Disconnect the all connectors on the DC controller PCB.
d. Unscrew the ten screws and remove the DC controller PCB.

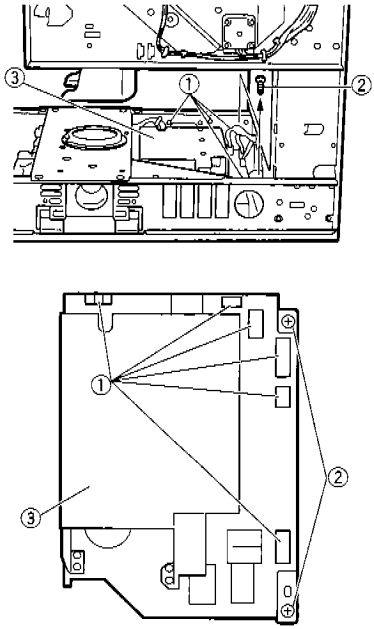


① Screws
② DC controller PCB

Fig. 4-401

B. Power Supply Unit

a. Remove the screen cover. (2 hooks)
b. Remove the lens.
c. Remove the carrier mount. (3 hex screws)
d. Remove the table cover.
e. Disconnect the six connectors ①, unscrew the two screws ②, and remove the power supply unit ③.



① Connectors
② Screws
③ Power supply unit

Fig. 4-402

f. For 220-240 V machine, Remove the two fixing pins and the duct sheet.
(Put these on the new Power supply unit.)

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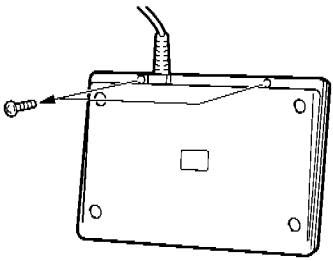
C. Keyboard (for MS500 only)

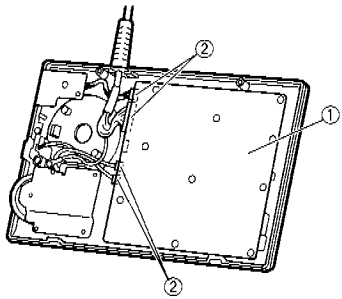
a. Unscrew the two screws ① and remove the rear cover ②.



① Screws
② Rear cover

Fig. 4-403

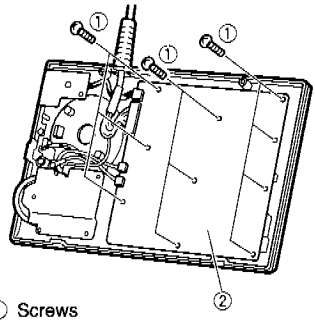
b. Disconnect the four connectors ② on the keyboard PCB ①. (Five connectors when the installation kit is used.)



① Keyboard PCB
② Connectors

Fig. 4-404

c. Unscrew the ten screws ① and remove the keyboard PCB ②.



① Screws
② Keyboard PCB

Fig. 4-405

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I. INSTALLATION SUGGESTION

The machine should be installed in a location that meets the following requirements. It is recommended that the serviceman personally inspect the customer's premises before installing the machine. The location should satisfy the following requirements:

■ The location should have an electrical outlet capable of supplying the required power. The supplied voltage should not vary by more than ±10% from the required voltage. The machine must be grounded for proper operation.

> The machine should be grounded in one of the following ways:
> 1) Ground terminal of the electrical outlet.
> 2) Copper rod buried at least 65 cm underground.
> 3) Water line that the utility company has certified as grounded. (Connection to a gas line is strictly prohibited.)

■ The temperature should be between 10 and 32.5°C, and the relative humidity between 20 and 80% RH. In particular, do not install the machine in the same room in which an ultra-sonic humidifier is used.

■ The machine should not exposed to naked flame, dust, direct sunlight or intensive vibration.
- In application where installation of the machine in a sunny environment is unavoidable, a heavy curtain should be installed on the windows to prevent the light from reaching the machine.
- In applications where the machine is installed in a bright location near windows, try to install the machine in a position so that the screen faces the dark side.

[The amount of ozone that generates while the File Print is in operation is negligible and will not cause adverse effects on persons in the room. However, if it is used in a poorly ventilated room for a long period of time, the odor may be unpleasant. Be sure to ventilate the room to maintain a pleasant working environment.]

■ Provide ample space around the machine for operation, maintenance and ventilation.

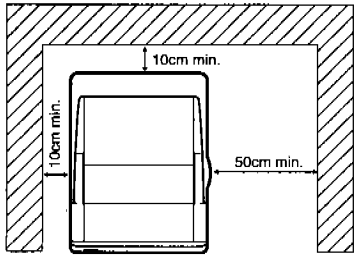

Fig. 5-1

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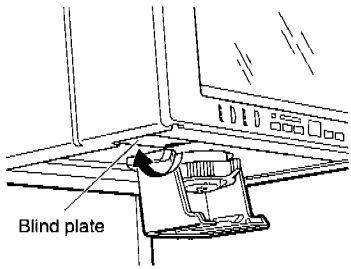
II. UNPACKING AND INSTALLATION

If the machine (in its shipping container) has been stored in a cold location, it should not be unwrapped in a warm room until it has had a sufficient amount of time to warm up, otherwise moisture can condense on the metal and glass parts. At least one hour should be allowed for the machine to warm up to room temperature before the shipping container is opened.

No.	Procedure	Inspection/Remarks
1	Open the shipping container.	
2	Take out parts and other materials.	Check that the following items are available: • MS400: 1) Main body 2) Power cord 3) Grounding line (100 V machines only) 4) Lens magnification indication labels 3 sheets 5) B5 label (100 V machines only) 6) Operation manual 7) Guarantee registration form (100 V machines only) 8) Guarantee form (120 V/LTR machines only) • MS500: 1) Main body 2) Power cord 3) Grounding line (100 V machines only) 4) Keyboard 5) Function key label 6) Lens holder 7) B5 lable (100 V machines only) 8) Operation manual 9) Guarantee registration form (100 V machines only) 10) Guarantee form (120 V/LTR machines only)
3	Transport the machine to the inspection location.	
4	Peel off all the filament tape on each unit.	Check all covers for possible damage during shipping.
5	Remove the blind plate at the bottom of the screen.	

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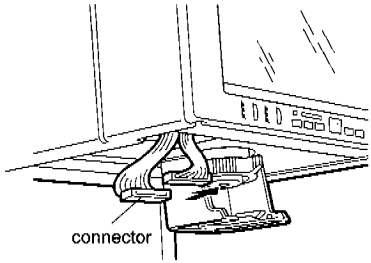
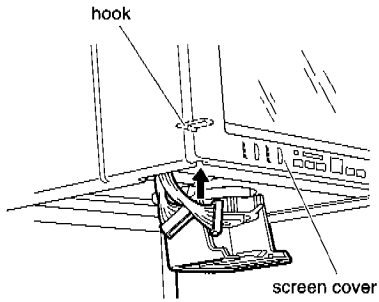
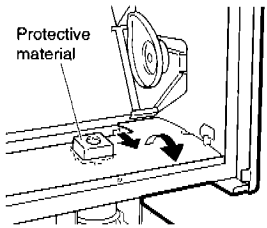
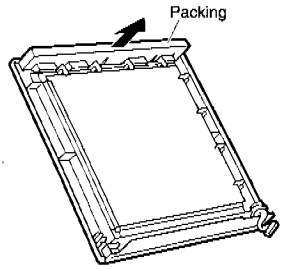
No.	Procedure	Inspection/Remarks
6	Pull out the cables and remove the connector. **Note:** 2pcs. on the machines with the area designation unit.	
7	Insert a screwdriver through the holes at the lower right and left sides of the screen, and release the hook to remove the screen.	
8	Remove the internal prism presser. • Pull the protective material to the front, remove the hook in the rear, and using the front as the fulcrum, turn and remove the protective material.	
9	Place the screen in a safe location, and remove the packing inside the upper part of the screen.	

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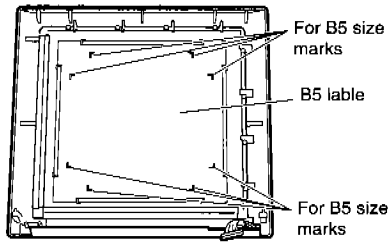
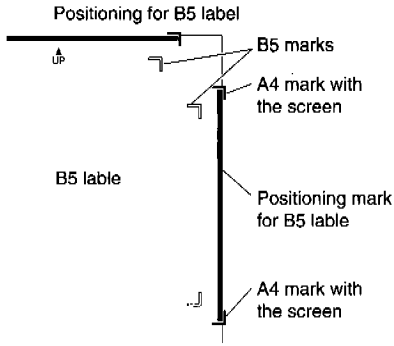
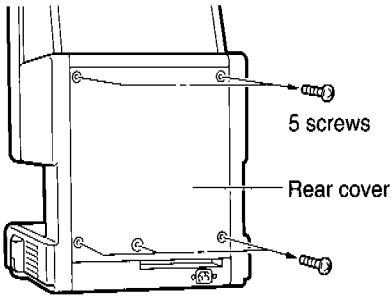
No.	Procedure	Inspection/Remarks
10	For B5 size paper used: Clean the rear of the screen, place B5 lable at the proper position, and make a print with the eight marks rubbed on the screen without damaging the screen.	 
11	Mount the area designation kit (Framing kit: option), if attached.	Refer to III. Area Designation Kit Mounting Procedure to be mentioned later.
12	Replace the screen to the original place.	
13	Remove the rear cover. (5 screws)	

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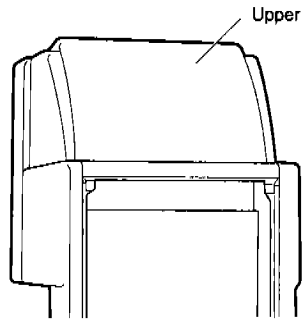
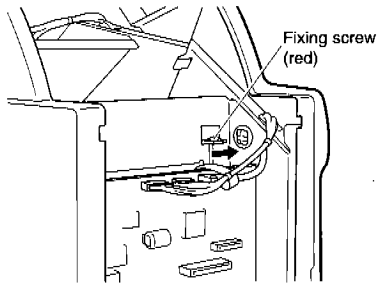
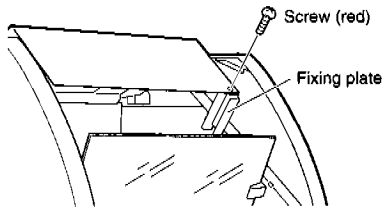
No.	Procedure	Inspection/Remarks
14	Remove the upper cover.	
15	Loosen the fixing screw (red) while holding the scanner unit by hand to allow the unit to move freely. Tighten the fixing screw in the next screw hole.	
16	Remove one screw and lift the scanner mirror to remove the fixing plate. **Note:** Do not drop the screw into the machine. **Note:** Keep the screw and fixing plate for when moving the machine. (Refer to VI. Works when moving the machine.)	

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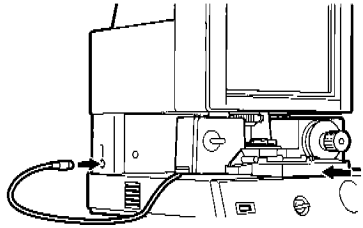
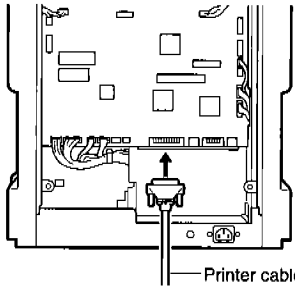
No.	Procedure	Inspection/Remarks
17	Install the carrier • Match the carrier guide with the carrier mount of the main body and shift them to the end. • For AC100C/R/M and FS Controller I, connect the cable to the connector on the side of the main body. **Note:** When installing the auto carrier, refer to IV. Auto Carrier Mounting Procedure to be described later.	Example 1: For FC190RII Example 2: For Auto Carrier 
18	Connect the printer cable.	
19	MS500: Connect the keyboard cable.	
20	Replace the upper cover and rear cover to the original places.	

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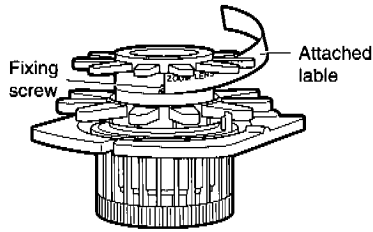
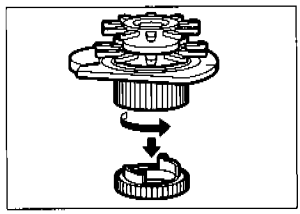
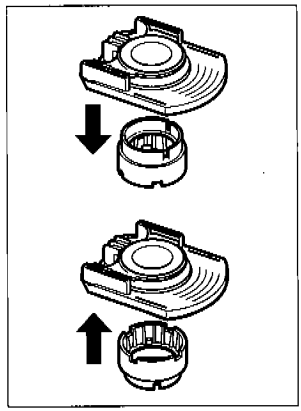
No.	Procedure	Inspection/Remarks
21	When using the zoom lens on MS400: Transfer the Lot No. on the magnification indication label already pasted to the attached label. Peel off the pasted label, and paste the attached label in such a position that the leading edge of the label may be at the center of the lens-fixing screw.	
22	When using FS Controller I: Change the bottom part of the lens, and then set it to the main body. • On MS400: Remove the bottom part of the lens. • On MS500: Remove the bottom part of the lens and mount it to the main body up-side down.	MS400:  MS500: 

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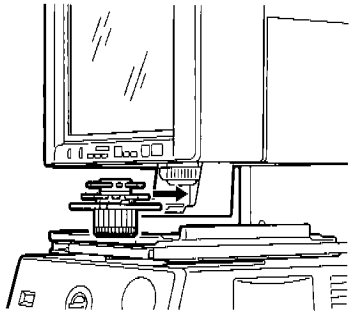
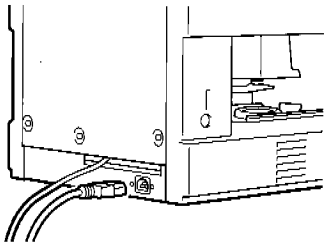
No.	Procedure	Inspection/Remarks
23	Set the lens to be used to the main body. **Note:** For MS500. Put the lens in the lens holder befor setting the lens.	
24	For MS500: Paste the attached function key labels to the function keys on the keyboard. • P1 ← DATE • P2 ← NOTE • P3 ← PICTURE • P4 ← SHARPNESS	
25	Connect the power cord.	
26	For 100 V machine: Connect the grounding wire attached.	
27	Supply the power to this machine. • Supply the power to the printer. • When FS Controller III is mounted, supply the power to the FS Controller III first.	Confirm that the screen becomes light.
28	Make sure that every operation is normal. Set the print mode and other special functions as needed, and make a print.	For each operation and setting method of this machine, refer to Chapter 1, IV. Description of Operation. • Set the Date/time. • Set the paper size of the paper tray. (Default: A series model → A4, inch series model → letter)

Note: Some screws and metal parts may protrude through the bottom plate of the machine; care should be exercised during transportation or movement.

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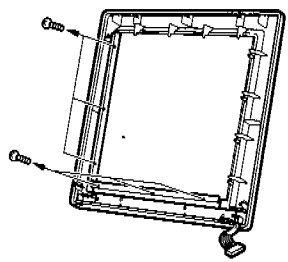
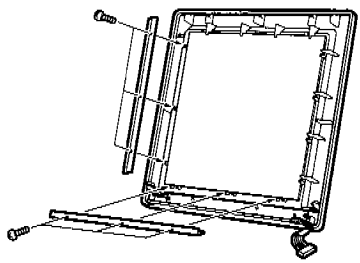
III. AREA DESIGNATION KIT MOUNTING PROCEDURE

Follow the procedure below when mounting the area designation kit to this machine.
(Proper discription of this kit is a Framing kit, but for understanding its function easily the Area Designation kit is used.)

No.	Procedure	Inspection/Remarks
1	Open the box and take out the parts.	Verify that the following parts are in the box: 1) Cursor X 2 2) Cursor Y 2 3) Screen fixing plate 2 4) Knob 4 5) Cursor rail 2 6) Area designation X unit 1 7) Area designation Y unit 1 8) Light-blocking sheet 1 9) Screws M3 × 8 (self-tapping) 8 M3 × 6 (washer-faced) 4
2	Remove the screen.	Refer to II. Unpacking and Installation No. 5 to 7.
3	Remove the two screen fixing plate already mounted. (screws 2 × 3)	
4	Mount the two screen fixing plate of the area designation kit. (screws 2 × 3) **Note:** Use the screws removed in No. 3.	

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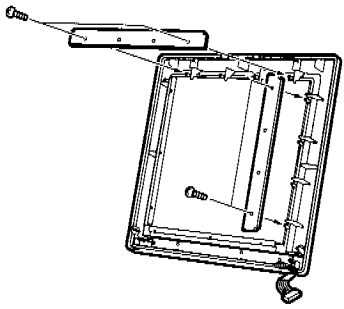
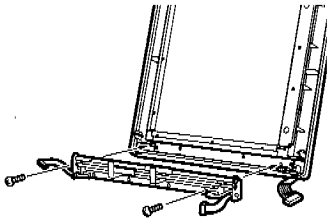
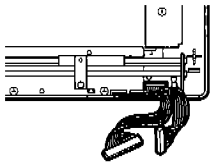
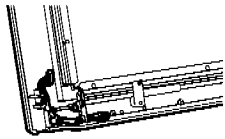
No.	Procedure	Inspection/Remarks
5	Mount the two cursor rails. (self-tapping screws 2 x 2) **Note:** Fix both ends of the cursor rails with screws.	
6	Mount the area designation X unit. (2 self-tapping screws) **Note:** The cable of the screen on the right side should be pulled out from the cutoff provided on the mounting plate of the area designation X unit . **Note:** The cable of the area designation X unit should be run down to the root of the rib. Make sure that the cable does not interfere with the area designation Y unit at the time when the unit is mounted.	 Right side  Left side 

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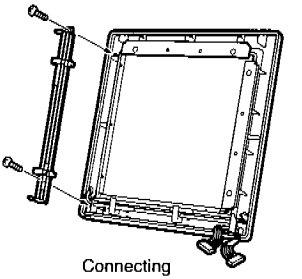
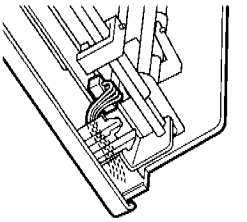
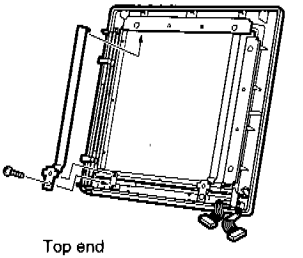
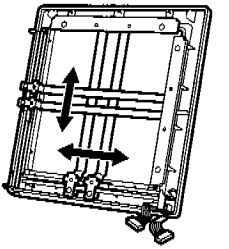
No.	Procedure	Inspection/Remarks
7	Mount the area designation Y unit. (2 self-tapping screws) Connect the cable of the area designation X unit to the connector. **Note:** The cable should be run down to the root of the rib.	 Connecting 
8	Mount the two cursors X to the area designation X unit. (Washer-faced screw 1 each) **Note:** Do not confuse with the cursor X and the cursor Y. (The cursor X is shorter in size of the bending height of the top end.) **Note:** Mount the cursors straight to the screen guide line when fixing the screws.	 Top end Cursor X Cursor Y
9	As in the cursors X, mount the two cursors Y to the area designation Y unit. (Washer-faced screw 1 each) After mounting the cursors, move the cursors X and Y by hand to make sure that they move smoothly and that they are mounted straight.	

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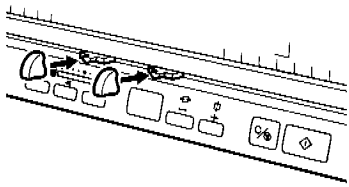
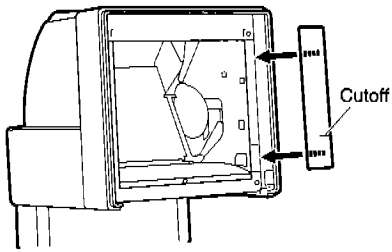
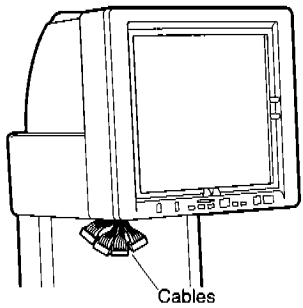
No.	Procedure	Inspection/Remarks
10	Mount the four knobs from the front side of the screen.	
11	Paste the light-blocking sheet to the mounting unit of the right side of the main body after peeling off the backing taped paper. **Note:** With the cutoff on the light-blocking sheet down, and fit it to the mounting shape.	
12	Replace the screen to the original place. Connect the two sets of connectors. Mount the blind plates with the cable inside.	
13	Turn the power on and check the functions.	For the operating procedure, refer to Chapter 1, IV. Description of Operation.
14	Adjust the positions of the area designation with service mode. And record that data on the service mode label.	Refer to Chapter 7, IV. Service Mode. (Adjust the address 6 and 7)

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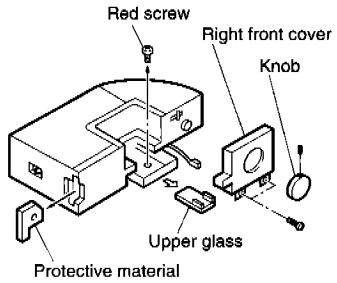
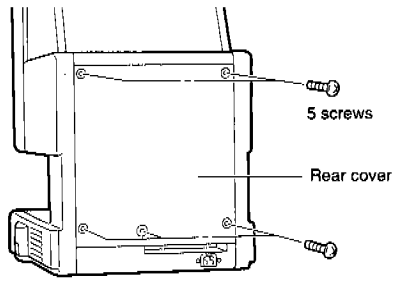
IV. AUTO CARRIER MOUNTING PROCEDURE

To mount the auto carrier, follow the procedure below.

No.	Procedure	Inspection/Remarks
1	Open the box of AC100C, AC100M, AC100R, or FS Controller I, and take out the carrier.	
2	Open the box of the installation kit L (for 100 V/120 V) or kit M (for 230 V/240 V) and take out the parts. **Note:** Some parts are not used on MS400/MS500.	Verify that the following parts are in the box: 1) Transformer 1 2) Control knob unit 1 3) Terminal PCB 1 4) Knob 1* 5) Grounding wire 1* 6) Locking support 4 7) Wire saddle 2* 8) Screws M4 × 6 4 (2 out of 4 screws *) M3 × 6 2* M3 × 8 self-tapping 2 M4 × 6 washer-faced 2* *: Not used for MS400/MS500
3	Remove all the filament tape of the carrier.	
4	To mount the AC100C, AC100M, or FS Controller I, follow the procedure below: a. Remove the upper glass, remove the red screw (1), and remove the protective material of the supply unit. b. Remove the knob (1 set screw) in the take-up chamber, remove the front right cover (2 screws), and peel off the filament fixing the take-up arm. c. Mount the knob in the take-up chamber and the right front cover which are removed in Step b.	
5	Remove the rear cover. (5 screws)	

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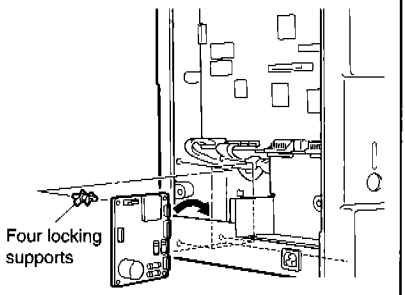
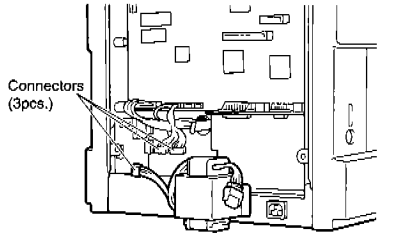
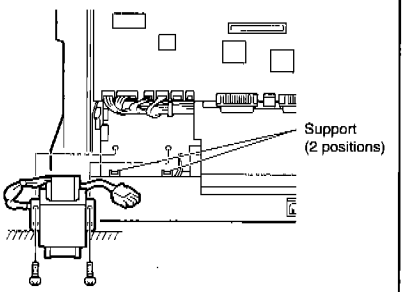
No.	Procedure	Inspection/Remarks
6	Mount the four locking supports to the side plate, and then mount the terminal PCB. **Note:** Mount the terminal PCB in such a manner that the electrolytic capacitor may point downward and that the three connectors may be rear side.	
7	Connect the three connectors as shown below. Be sure that the 5P and 8P connectors of the main body must be pulled out from the harness band before connecting. • Connect the 6P connector from the transformer to the connector (J1001) of the terminal PCB. • Connect the 5P connector of the main body to the connector (J1002) of the terminal PCB. • Connect the 8P connector of the main body to the connector (J1003) of the terminal PCB.	
8	Place the bottoms of both left and right mounting plates of the transformer on the support of the main body, and fix the two positions on each upper right and left sides with the screws.	
9	Connect the 3P connector of the transformer to the connector of proper line voltage to be used of the main body (AC line). **Note:** There are two connectors attached to the main body; one with 100/230 label and other with 120/240 . **Note:** In the case of 240 V, insert the dummy connector to the 230 V connector, and then insert it to the 240 V connector.	Labels of the connectors according to the types of the source voltage. a. 100 V, 220 V, 230 V → 100/230 b. 120 V, 240 V → 120/240

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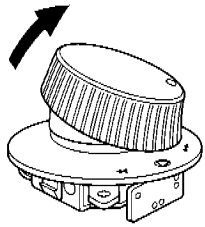
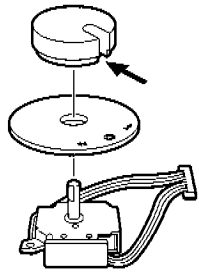
No.	Procedure	Inspection/Remarks
10	Replace the rear cover to the original place.	
11	To mount the AC100C, AC100M, or AC100R, follow the procedure below. To mount the FS Controller I, follow the procedure from No. 27.	
12	Remove the knob cap of the control knob unit.	
13	Turn the knob of the control knob unit when it cloiks and stop. Loosen the set screw and take out the knob and speed control panel.	

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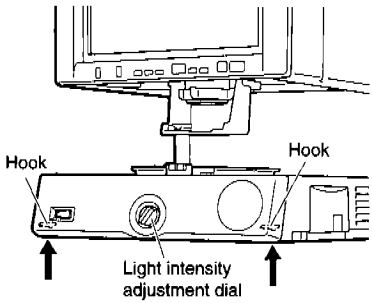
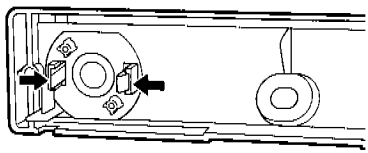
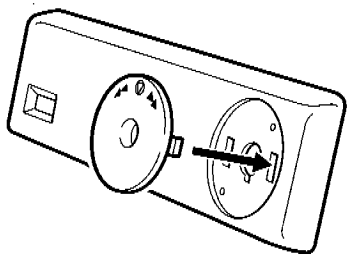
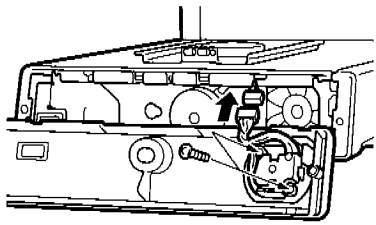
• For MS400 (For MS500, refer to the steps from No. 20 on.)

No.	Procedure	Inspection/Remarks
14	Pull out the light intensity adjustment dial, insert a screwdriver through the holes at the lower right and left on the lower front cover, release the hook to remove.	
15	Remove the blind plate on the lower front cover by releasing the hooks (2 positions) from the rear.	
16	Mount the speed control panel to the lower front cover.	
17	Mount the volume unit to the lower front cover. (2 screws) Connect the cable to the connector on the main body.	

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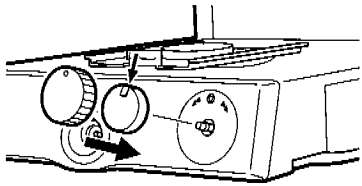
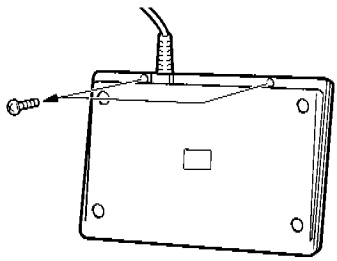
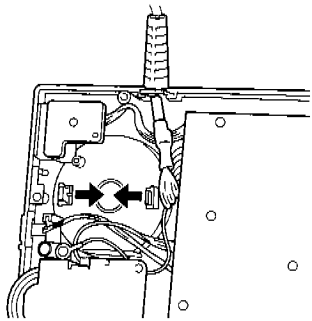
No.	Procedure	Inspection/Remarks
18	Replace the lower front cover and light intensity adjustment dial to the original positions.	
19	Fix the knob to the volume units with the set screw, and mount the knob cap to the knob. **Note:** Make sure that a circle on the knob cap agrees with a triangle mark ▽ on the speed control panel.	

• For MS500

No.	Procedure	Inspection/Remarks
20	Remove the rear cover of the keyboard. (2 screws)	
21	Remove the blind plate on the control panel by releasing the hooks (2 positions) from the rear.	

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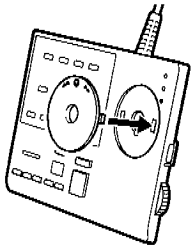
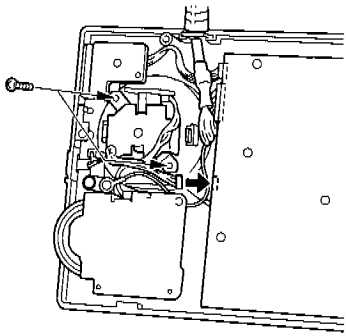
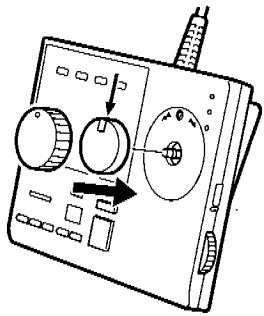
No.	Procedure	Inspection/Remarks
22	Mount the speed control panel to the control panel.	
23	Insert the volume unit to the connector (J602) on the keyboard PCB, and fix it with two screws.	
24	Replace the rear cover of the keyboard to the original place. (2 screws)	
25	Fix the knob to the volume unit with the set screw, and mount the knob cap to the knob. **Note:** Make sure that a circle on the knob cap agrees with a triangle mark ▽ on the speed control panel.	

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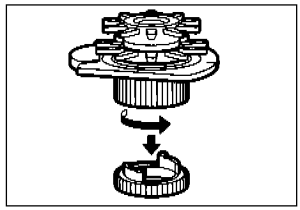
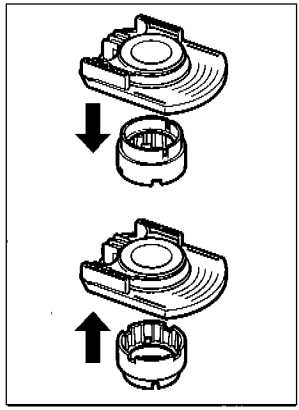
• For both MS400/MS500

No.	Procedure	Inspection/Remarks
26	For AC100R: Adjust film trailing end detection. Refer to the steps from No. 31 to No. 34.	
27	Install the carrier to the carrier mount.	
28	Connect the carrier cable from the carrier to the MS400/MS500 machine body.	
29	FS controller I: Change the bottom part of the lens, and mount the lens to the main body. • For MS400, remove the bottom part of the lens. • For MS500, remove the bottom part of the lens, and mount it to the main body up-side down.	For MS400  For MS500 
30	Mount the lens to the main body.	

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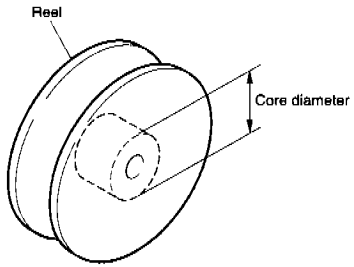
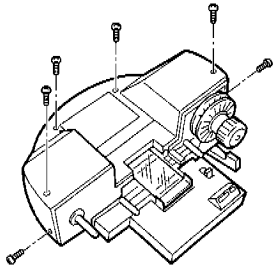
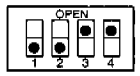
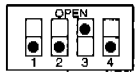
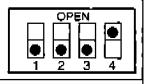
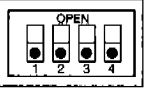
• Adjusting the film trailing end detection for AC100R

No.	Procedure	Inspection/Remarks
31	Check the film used in the following procedure. a. Take off the film from the reel, and measure the core diameter (outer diameter) of the reel. b. Check the film thickness. **Note:** A 4-mil film is handled as a 5-mil film.	
32	When the core diameter of the reel is 33 mm and the thickness of the film is 5 mil, no adjustment is necessary.	
33	Remove the carrier cover. (6 screws)	
34	Set the dip switch (DS1) on the CPU PCB as shown at right. **Note:** In this case, the thickness of the film are 2.5 and 5 mil, and the core diameter of the reel are ø32 and ø33 mm, set the switch with a film thickness of 5 mil and a core diameter of ø33 mm.	

	Core dia. of reel (mm)	Film thickness (mil)	Dip switch DS1
1	ø32	2.5	
2	ø33	2.5	
3	ø32	5	
*4	ø33	5	

* No. 4 is factory default.

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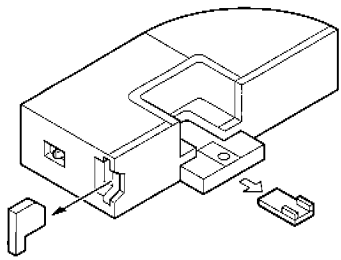
V. FS CONTROLLER III (for MS400/500) MOUNTING PROCEDURE

A. Installation

If the machine (in its shipping container) has been stored in a cold location, it should not be unwrapped in a warm room until it has had a sufficient amount of time to warm up, otherwise moisture can condense on the metal and glass parts. At least one hour should be allowed for the machine to warm up to room temperature before the shipping container is opened.

Follow the procedure bellow after MS400/500 is installed.

No.	Procedure	Inspection/Remarks
1	Open the shipping container.	
2	Take out parts and other materials. At this time, record the value of the label on the rear of FS carrier.	Check that the following itmes are available: • FS carrier • Keyboard • Control box • Carrier mounting plate • Sensor positioning label • Power cord • Communication cable • Screws M4 × 6: w/toothed washer, 1pc. M4 × 8: bind, 1pc. M4 × 10: bind, 4pcs. • Legs: 2pcs. • Grounding wire (100 V machines only) • Operation manual • Installation instruction manual • Guarantee registration form (100 V machines only)
3	Peel off all the filament tape on each unit.	
4	Remove the upper glass. Push the take out lever of the cartridge, and remove the protective material of the supply unit.	

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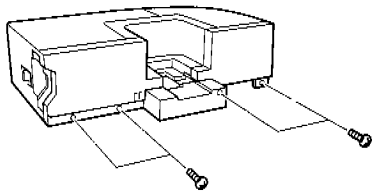
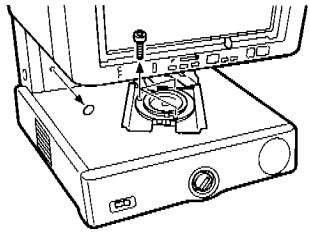
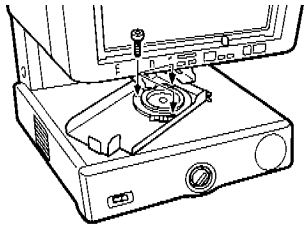
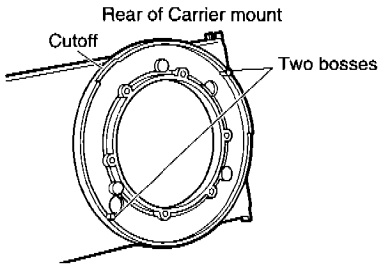
No.	Procedure	Inspection/Remarks
5	Unscrew the four screws, remove the right cover and left cover, and then remove the protective material of the take-up arm.	
6	Remove the MS400/500 carrier mount. (3 hex screws) Then remove the mounting plate (3 bind screws), and peel off the blind label on the rear cover.	
7	Mount the attached carrier mounting plate to the carrier mount. Mount the carrier mount to the main body of MS400/500. Then, with the cutoff on the resin part of the carrier mount on front side, insert the two bosses on the rear side to the holes on the metal sheet of the main body of MS400/MS500 to position.	 

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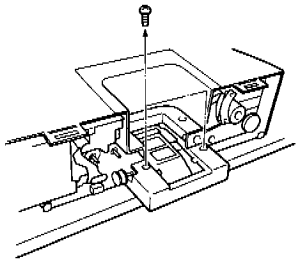
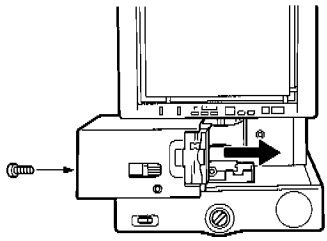
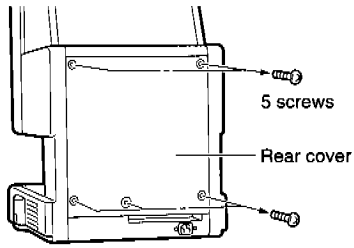
No.	Procedure	Inspection/Remarks
8	Unscrew the two screws and remove the center cover.	
9	Match the FS carrier guide with the carrier mounting guide and insert the FS carrier, and fix it with the screw (M4 × 6: w/toothed washer).	
10	Replace the center cover, the right cover and the left cover of the FS carrier to the original place. (6 screws)	
11	Replace the upper glass to the original place.	
12	Remove the rear cover of the MS400/500. (5 screws)	

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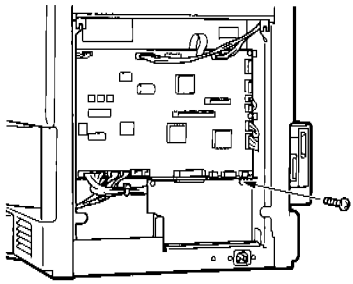
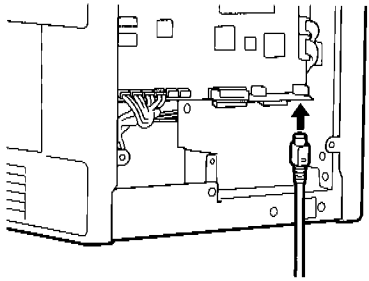
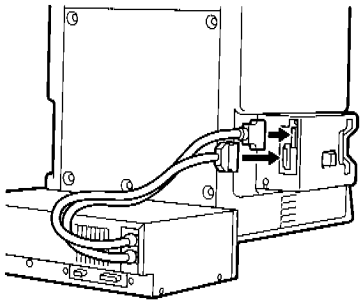
No.	Procedure	Inspection/Remarks
13	Fix the FS carrier to the main body of MS400/500 from the rear with screws (M4 × 6: bind).	
14	Connect the communication cable to the connector (J118) on the DC controller PCB.	
15	Turn on the bit 4 of the dip switch (SW103) on the DC controller PCB.	
16	Replace the rear cover to the original place. (5 screws)	
17	Connect the two cables from the control box to the FS carrier.	

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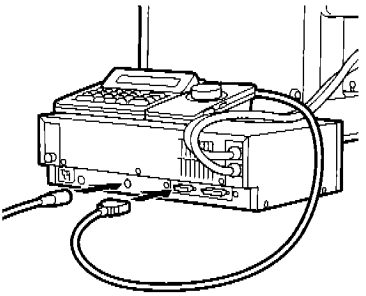
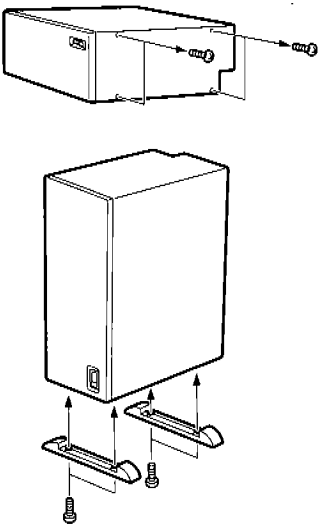
No.	Procedure	Inspection/Remarks
18	Connect the keyboard cable and the communication cable from the main body to the control box.	
19	Connect the foot switch cable if necessary.	
20	If the control box is set vertically, unscrew the four screws of the control box, and mount the two legs to the bottom of the box with attached four screws (M4 × 10, bind).	
21	Set the lens to be used on the main body of MS400/MS500. **Note:** In the case of MS500, first put the lens in the lens holder and then set it.	
22	Insert the power plug of the FS controller III and turn on the power switch. Next, turn on the power switch of MS400/MS500 and the printer.	• Check that the screen becomes bright. • Try inputting with the keys of the keyboard and check that they are properly displayed.

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No.	Procedure	Inspection/Remarks
23	Adjust the position of the mark sensor.	Refer to Page 5-27 for the adjustment method.
24	Carry out default set up.	Refer to Chapter 6 of the FS Controller III Service Manual for the setting method.
25	Set user mode.	Refer to Page 5-29 for the setting method.
26	Set search mode.	Refer to Chapter 6 of the FS Controller III Service Manual for the setting method.
27	Set the cartridge in the FS carrier.	Check that loading begins automatically and that the leading end of the film is wound on the winding pulley.
28	Rewind the film and search.	Check that search is properly carried out.

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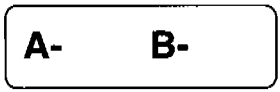
B . Adjusting Mark Sensor Position

1. Outline

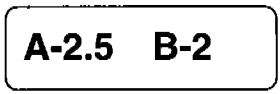
The position of the mark recorded on the film differs if different cameras are used. Adjust the position of the mark sensor upon installation or when using film exposed by different cameras.

2. Adjustment

a. Take note of the value on the positioning labels at the rear of the supply unit of the carrier.
   A: Location of the sensor positioning label (Ch. A ... bottom of screen)
   B: Location of the sensor positioning label (Ch. B ... top of screen)



b. Attach the sensor positioning labels aligning them with the indexes on the screen. The labels are of three types, i.e., X24, X42, and X48; use the labels suited to the reproduction ratio of the lens used.
   For example, if the values on the labels are 2.5 for A and 2 for B, attach the labels so that '2.5' is aligned with the index of the screen for Ch. A, and '2' is aligned with the index on the screen. for Ch B.



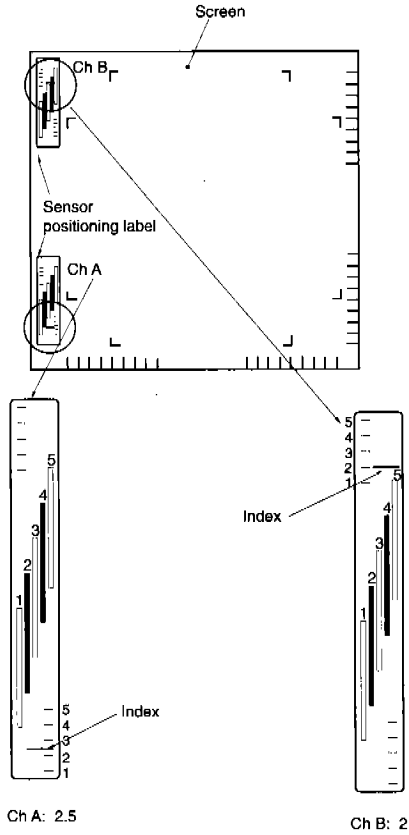


Fig. 5-2

c. Set a cartridge, and feed film.
d. Align the bottom edge of the film with the inside edge of the silk frame.

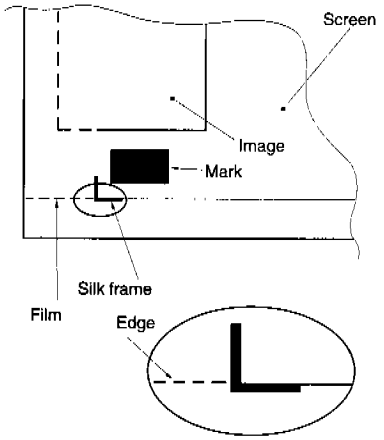


Fig. 5-3

e. Take note of the mark position of the mark on the film in relation to strips 1 through 5 on the sensor positioning label.

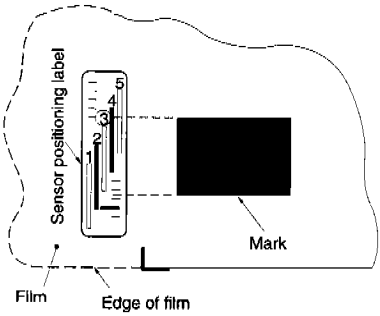


Fig. 5-4

f. Set the sensor positioning dial (Ch. A) to the value noted in step e.
g. Align the top of the film with the inside edge of the silk frame.

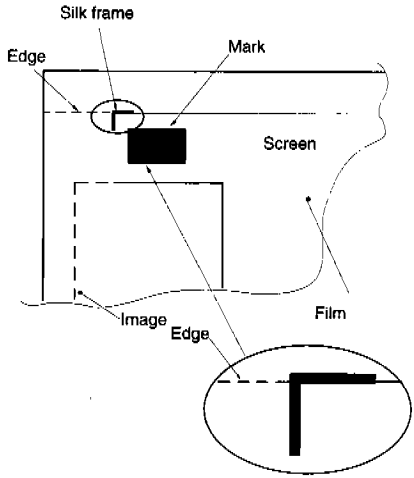


Fig. 5-5

h. Take note of the mark position of the mark on the film in relation to strips 1 through 5 on the sensor positioning label.

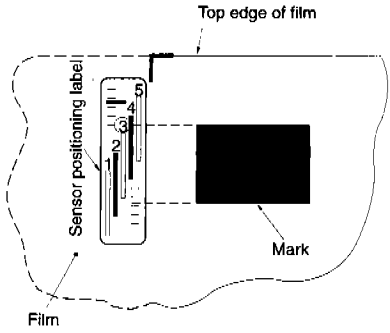


Fig.5-6

i. Set the sensor positioning dial (Ch. B) to the value read in step h.
j. Adjust the image on the screen so that it is inside the silk frame.
k. To position the sensors when the magnification ratio of the lens used by the user is other than X24, X42, or X48, use the sensor positioning correction sheet which is attached in Appendix of FS Controller III Service Manual.

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C. User Mode

1. Machine Set-up

Choose user modes for the FS controller III. The user mode of each item at shipping from the factory is shown below.

No.	Item	Default
1	• Automatic ejection of cartridge. Decides whether the cartridge should be ejected after the film has been rewound.	Automatic ejection
2	• Automatic ON/OFF of illumination lamp. Decides whether the illumination lamp should be turned ON/OFF automatically when the cartridge is rewound.	Automatic ON/OFF
3	• Opening/Closing of screen shutter. Decides whether the screen shutter should be left open or closed during retrieval. (Turning the lamp ON/OFF on FS Controller III)	Closed
4	• Direction of manual control knob. Decides the direction of the manual control knob in relation to film direction.	Knob rotated clockwise to take up film.
5	• Set ON/OFF of address print. Set print/no print of address.	No print
6	• Automatic back and forth movement of carrier. Decides whether the movement of carrier should be automatic or manual.	Automatic movement
7	• Assignment of foot switch command. Assigns the foot switch command.	PRINT

Table 5-1

To change the defaults, proceed as follows:

① While holding the SHIFT key down, press the MODE key to enter the user mode. Make sure the following message is displayed.

[2 MACHINE SET UP]

If the above message is not displayed, press the +/YES or −/NO key to have it displayed.

② Press the SEARCH/ENTER key.

[CTRDG OUT] will be displayed.

③ Automatic Ejection of cartridge
- To choose automatic ejection of the cartridge, Press the +/YES key.
- To cancel automatic ejection of the cartridge, Press the −/NO key.

④ Press the SEARCH/ENTER key.

[LAMP AUTO] will be displayed.

⑤ Automatic ON/OFF of Illumination Lamp
- To choose automatic ON/OFF, Press the +/YES key.
- To cancel automatic ON/OFF, Press the −/NO key.

⑥ Press the SEARCH/ENTER

[SHUTTER ON] will be displayed.

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⑦ Opening/Closing of Screen Shutter
- To choose using,
  Press the [+/YES] key.
- To cancel using,
  Press the [−/NO] key.

⑧ Press the [SEARCH/ENTER] key.

[KNOB CW=FWD] will be displayed.

⑨ Direction of Manual Control Knob
When the knob is turned clockwise,
- If the film should be taken up (images from right to left),
  Press the [+/YES] key.
- If the film should be rewound (images from left to right),
  Press the [−/NO] key.

⑩ Press the [SEARCH/ENTER] key.

[ADDRESSS PRT] will be displayed.

⑪ Set ON/OFF of address print
- When printing address,
  Press the [+/YES] key.
- When not printing address,
  Press the [−/NO] key.

⑫ Press the [SEARCH/ENTER] key.

[AUTO SCAN] will be displayed.

⑬ Automatic back and forth movement of carrier
- To choose automatic back and forth movement,
  Press the [+/YES] key.
- To choose manual back and forth movement,
  Press the [−/NO] key.

⑭ Press the [SEARCH/ENTER] key.

[MODIFY FT-SW] will be displayed.

⑮ Assignment of Foot Switch Command
- To change the command assigned,
  Press the [+/YES] key.
  Press [SEARCH/ENTER] key.

[F-SW] will be displayed.

Press the command key desired; possible commands are [PRINT], [SEARCH], [BRW], [+], [−], and [REWIND]. If assignment of an address is also desired, specify the address from the ten keys and press the command key. For example, if an address and [PRINT] are both assigned, the message [F-SW XXXXPR] will be displayed.
- To keep the command already assigned, press the [−/NO] key.

[INPUT OK?] will be displayed.

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⑯ Check the settings.
- If the settings are as desired,
  Press the [+/YES] key.
- To correct the settings,
  Press the [-/NO] key.

⑰ Press the [SEARCH/ENTER] key.
- If the [+/YES] key is pressed in ⑭ above, [2 MACHINE SET UP] will be displayed.
- If the [-/NO] key is pressed in ⑭ above, [CTRDG OUT] will be displayed.

Go back to ③ above and repeat the operations.

⑱ Press the [+/YES] or [-/NO] key. [3 EXIT] will be displayed.

⑲ Press the [SEARCH/ENTER] key.

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2. Image management code set-up

To use the image management code data with the FS controller III, first set up each item in the [MODE F SETUP] menu.
The mode of each item of shipment from the factory is shown below.

No.	Item	default
1	• Cartridge number Enable or disable the cartridge number on the image management code.	YES
2	• Search number Enable or disable the search number on the image management code.	YES
3	• Modifier Enable or disable the modifiers on the image management code.	YES
4	• Image offset position Enable or disable the image offset position on the image management code.	YES
5	• Magnification Enable or disable the print magnification on the image management code.	YES
6	• Print polarity Enable or disable the print polarity on the image management code.	YES

NOTE: When Set "NO" at No.2 Search number [F SER PROG#], No.3 Modifier [F MODIFIER] is not displayed.

Table 5-2

To change the defaults, proceed as follows:

① While holding the SHIFT key down, press the MODE key.
Make sure the following message is displayed.

[3 MODE F SETUP]

If the above message is not displayed, press the +/YES or −/NO key to have it displayed.

② Press the SEARCH/ENTER key.

[F CARTRDGE#] will be displayed.

③ Enable or disable the cartridge number on the image management code.
- To enable the contents, press +/YES key.
- To disable the contents, press −/NO key.

④ Press the SEARCH/ENTER key.

[F SER PROG#] will be displayed.

⑤ Enable or disable the search number on the image management code.
- To enable the contents, press +/YES key.
- To disable the contents, press −/NO key.

⑥ Press the SEARCH/ENTER key.
- If the +/YES key is pressed in t above, [MODIFIER] will be displayed.
  Proceed to u.
- If the −/NO key is pressed in t above, [PSN OFFSET] will be displayed.
  Proceed to o.

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⑦ Enable or disable the modifiers on the image management code.
- To enable the contents, press +/YES key.
- To disable the contents, press -/NO key.

⑧ Press the SEARCH/ENTER key.

[PSN OFFSET] will be displayed.

⑨ Enable or disable the image offset position on the image management code.
- To enable the contents, press +/YES key.
- To disable the contents, press -/NO key.

⑩ Press the SEARCH/ENTER key.

[F MAG/RATIO] will be displayed.

⑪ Enable or disable the print magnification on the image management code.
- To enable the contents, press +/YES key.
- To disable the contents, press -/NO key.

⑫ Press the SEARCH/ENTER key.

[PRINT N/P] will be displayed.

⑬ Enable or disable the print polarity on the image management code.
- To enable the contents, press +/YES key.
- To disable the contents, press -/NO key.

[INPUT OK?] will be displayed.

⑭ Check the settings.
- If the settings are as desired, press the +/YES key.
- To correct the settings, press the -/NO key.

⑮ Press the SEARCH/ENTER key.
- If the +/YES key is pressed in !4 above,

[3 MODE F SETUP] will be displayed.

- If the -/NO key is pressed in !4 above,

[F CARTRDGE#] will be displayed.

Go back to e above and repeat the operations.

⑯ Press the +/YES or -/NO key.

[4 EXIT] will be displayed.

⑰ Press the SEARCH/ENTER key.

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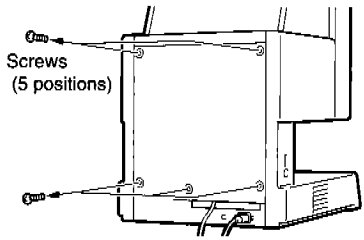
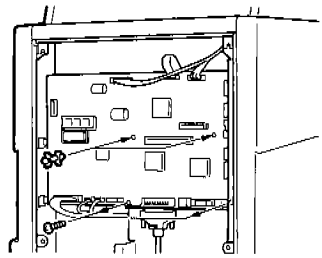
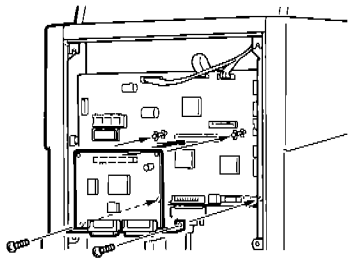
VI. SCSI BOARD MOUNTING PROCEDURE

When mounting the SCSI board on the main body, the procedure below should be followed.

No.	Procedure	Inspection/Remarks
1	Remove the rear cover (5 screws)	
2	Unscrew the two screws at the lower side of the DC controller PCB and mount the locking supports (2pcs.).	
3	Mount the SCSI board. • Insert the upper part of the SCSI board to the machine body with the board matched with the connector and locking support. • Fix the lower part with the screws removed in No. 2.	

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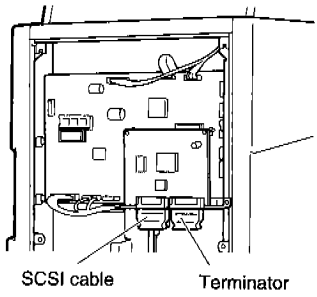
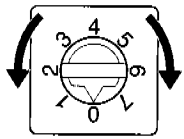
No.	Procedure	Inspection/Remarks
4	Connect the SCSI cable to one of the two connectors of the lower part of the SCSI board. Connect the terminator to the other connector.	
5	Set the ID of SCSI by the dip switch (SW 101) on the SCSI board.	
6	When using FS Controller III (MS400/500), put SCSI Mode of Car Set Up Mode (3 CAR ADJ) on YES.	Refer to Chapter 6 of FS Controller III Service Manual for the setting method.

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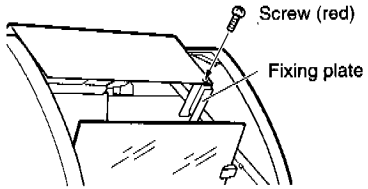
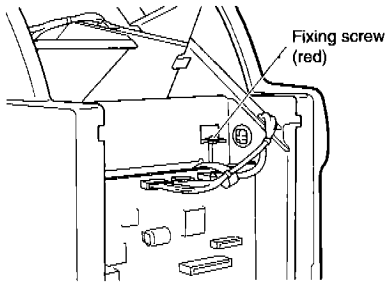
VII. WORK WHEN MOVING MACHINE

When moving this machine for some reason to another location, after it has been installed, carry out the following work.

No.	Procedure	Inspection/Remarks
1	Remove the carrier and lens.	
2	Remove the printer cable, power cord and cables connecting other external equipment.	
3	Secure the scanner mirror with the fixing plate and screw (red).	
4	Secure the scanner unit with the fixing screw (red).	

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I. PARTS TO BE PERIODICALLY REPLACED

No parts to be replaced periodically.

II. CONSUMABLE PARTS

There are some parts that might have to be replaced at least once in the guarantee period because of deterioration or breakdown of the parts but require replacement only when they become defective. The following are the estimated average life expectancy of these parts.

As of November 1, 1996

NO.	Name	Part No.	Quantity	Average life expectancy	Remarks
1	Illumination lamp	MH7-3035	1	500 hours	

Table 6-1

When the illumination lamp light intensity is made brighter (applied voltage to the lamp increases with brightness adjustment), the above life span of the lamp might decrease.

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III. LIST OF PERIODIC SERVICING

Note: Do not use solutions/oils other than recommended.

[△: Cleaning, ●: Replacement, ☆: Oiling, □: Adjustment, ◎: Inspection]

Unit	Position	Maintenance intervals			Remarks
		Installation	At periodic servicing	As required	
Optical path	Field lens	△	△		Clean with a blower brush.
	Lens	△	△		
Carrier	Carrier glass	△	△		Clean with a blower brush.
Light source assembly	Illumination lamp			●	500 hours

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IV. BASIC PROCEDURE FOR PERIODIC SERVICING

Note: Before visiting the customer for periodic servicing, check the record. If parts replacement is anticipated, be sure to bring the parts.

No.	Procedure	Inspection	Remarks
1	Greeting the person in charge	Observation of situation	
2	Set the test film and print.	• Check print quality • Abnormal noise	
3	Optical path cleaning • Carrier Glass • Lens • Field lens		
4	Cleaning of all the printer parts		
5	Take the test prints Arrange the machine environment	• Check print quality	
6	Enter necessary items in the service notebook, and report to the person in charge.		

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Process Procedure Chart Usage

The process procedures used in this chapter are ordinary flow charts that have been changed into charts. In the example given below, the chart usage is explained.
Example: AC power is not supplied.

Cause	Step	Check item	Result	Countermeasure
Power plug	1	Is the plug properly inserted into the socket?	NO	Insert the plug
Front door, delivery assembly	2	Are the front door and the delivery assembly securely closed?	NO	Close the doors
Circuit breaker	3	Is the circuit breaker in the ON position?	NO	Turn ON the breaker
Supply voltage	4	Is the supply voltage at the rated voltage?	NO	This is not a trouble of this machine, therefore, contact the customer.
Door switch assembly	5	If a screwdriver is inserted into the door switch and function board is pushed, is power supplied?	YES	Verify the door switch actuator action. If found to be bad, readjust.

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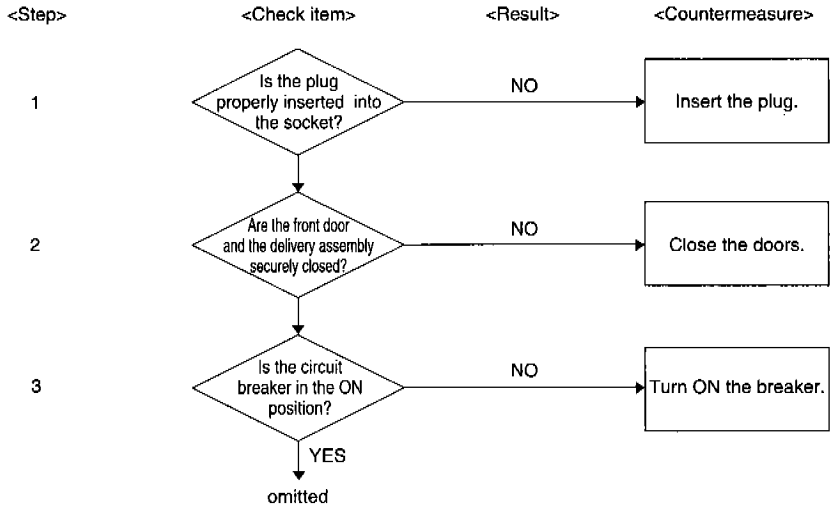
- If you want to know the possible cause (the part name you think is defective) for one problem, refer to the entry "cause" in the chart.
  In the above chart "AC power is not supplied" the possible defective parts are the power plug, front door, delivery assembly, circuit breaker, supply voltage, and door switch, etc.

- When you want to know the countermeasure or step check for one problem, follow the number of the "step" entry and check it. Evaluate the result of the "check item" question as a YES or NO. If the result matches the "result" entry, do the countermeasure listed in the "countermeasure" entry. If the result does not match, go to the next step and check as above.



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I. TROUBLESHOOTING FOR IMAGE FAULTS

A. Initial Check

1. Setup Environment

- Supply voltage should be within ±10% of the standard voltage
- This machine should not be exposed to high temperature high humidity (near water faucets, water heater, humidifier) cold locations, open flame, or dusty areas.
- This machine should not be exposed to direct sunlight. In applications where installation of the machine in a sunny location is unavoidable, the customer should be advised that a curtain should be installed.
- The location should have good air circulation.
- The location should have a level surface.

2. Checking the Film for Each Phenomenon

- Confirm whether the problem is in the film or the machine.
- The proper print density should be 9 ±2 graduations.
- Confirm the film density.
  Example:
  If the film density is low; easy to mistake for haziness.
  If the film density is high; easy to mistake for light image.

3. Checking the Machine for Each Phenomenon

Confirm whether the problem is in the machine or from the LBP.

4. Check dirt or scratches are on the carrier glass.

If it is dirty, clean with a synthetic detergent or alcohol. If there are scratches, replace it.

5. Print Paper Confirmation

- Check whether the recommended CANON paper is being used.
- Check whether or not the paper is moist.
  Set fresh paper and try printing.

6. Checking the BASIS Unit

When there is a thin line(s) on the print image as shown in Fig. 7-1, it is possible that some dirt is on the surface of the BASIS unit glass. Therefore check whether or not there is dirt on the glass.

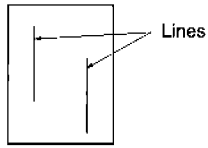

Figure 7-1

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7. Others

For installation in winter, if the machine is brought to a warm location after it has been stored in a cold location, condensation will form inside the machine leading to various problems.

Example:

- The image will be faint because of condensation in the optical system (glass, mirror, lens etc.)
  If condensation forms, either dry the part with a dry rag or leave the machine ON for one hour.

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B. Process Procedures for Image Problems

1	Light Image

Cause/ Problem location	Step	Check item	Result	Countermeasure
Film	1	Is the film at the density correct? Even if test film is used is the image still light?	NO	This is not a problem in this machine.
Optical system dust	2	Is the lens, carrier glass, the upper surface of prizes, or No. 4 mirror dirty?	YES	Clean
Glass dirty	3	Is the surface of glass dirty?	YES	Replace the glass.
Halogen lamp	4	Is the lamp set to the socket correctly?	NO	Make sure that the lamp is inserted to the bottom of the socket without inclination.
LBP	5	Is the LBP normal?	NO	If the toner amount is low, replace the LBP cartridge.
BASIS unit	6	Is the image density uneven?	YES	Replace the BASIS unit and see what happens.
DC controller	7	Enter the service mode by pushing the push switch (SW102) on the DC controller. Change the service mode 16 address data to 04 (data print mode), then push the AE key.	YES	Replace the DC controller and see what happens.
BASIS unit		Is the print image also light?	NO	Replace the BASIS unit and see what happens.

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2 Completely White

Cause/ Problem location	Step	Check item	Result	Countermeasure
BASIS cable	1	Is the BASIS cable properly inserted into the connector?	NO	Insert the connector.
BASIS unit	2	Enter the service mode by pushing the push switch (SW102) on the DC controller. Change the service mode 16 address data to 04 (data print mode), then push the AE key. Is the print image also completely white?	NO	It is concluded that the cause is in the BASIS unit.
LBP	3	Push the LBP test print switch. Is the test print image also completely white?	YES	Check the LBP.
DC controller, printer cable			NO	It is concluded that the cause is in the cable between this machine and the LBP or the DC controller.

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3 Completely Black

Cause/ Problem location	Step	Check item	Result	Countermeasure
BASIS cable	1	Is the BASIS cable properly inserted into the connector?	NO	Insert the connector.
BASIS unit	2	Enter the service mode by pushing the push switch (SW102) on the DC controller. Change the service mode 16 address data to 04 (data print mode), then push the AE key. Is the print image also completely white?	NO	It is concluded that the cause is in the BASIS unit.
LBP	3	Push the LBP test print switch. Is the test print image also completely black?	YES	Check the LBP
DC controller			NO	It is concluded that the cause is in the DC controller.

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4 Vertical Scanning Direction Line Light Image

Cause/ Problem location	Step	Check item	Result	Countermeasure
LBP	1	Push the LBP test print switch. Is there a line in the test print image also?	YES	Check the LBP.
DC controller PCB	2	Enter the service mode by pushing the push switch (SW102) on the DC controller. Change the service mode 16 address data to 04 (data print mode), then push the AE key. Is there a line in the test print image also?	YES	It is concluded that the cause is in the DC controller PCB.
Dirt on the BASIS surface	3	If the BASIS surface is cleaned, does the image improve?	YES	OK
BASIS unit			NO	Replace the BASIS unit.

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II. TROUBLESHOOTING FOR FUNCTION FAULTS

1	AC power in not supplied

Cause/ Problem location	Step	Check item	Result	Countermeasure
Power plug	1	Is the plug properly inserted into the socket?	NO	Insert the plug.
Supply voltage	2	Is the supply voltage at the rated voltage?	NO	This is not a problem of the main body. Explain this to the customer.
Main switch (SW1)	3	Is there continuity between both sides of the main switch?	NO	Replace the main switch.
Wiring			YES	Check the wiring.

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2 DC power is not supplied

<table>
<tr><th>Cause/
Problem location</th><th>Step</th><th>Check item</th><th>Result</th><th>Countermeasure</th></tr>
<tr><td>AC power supply defective</td><td>1</td><td>Is the AC power being supplied between connector J801-1 and 3 on the DC power PCB?</td><td>NO</td><td>Repeat the same procedure as in the case when AC power is note supplied.</td></tr>
<tr><td></td><td>2</td><td>Is the DC controller PCB LED 103 -LED106 lit up?</td><td>NO</td><td>Perform step 3.</td></tr>
<tr><td>DC controller PCB</td><td>3</td><td>Set the tester range to 30 VDC. Touch the tester probe to the DC power PCB terminals shown below. Is the rated voltage output the same as shown below?
<table>
<tr><th>⊖ probe</th><th>⊕ probe</th><th>Voltage</th></tr>
<tr><td>J101 - 3</td><td>J101 - 1</td><td>+5V</td></tr>
<tr><td>J101 - 4</td><td>J101 - 2</td><td>+5V</td></tr>
<tr><td>J101 - 6</td><td>J101 - 5</td><td>+15V</td></tr>
<tr><td>J101 - 6</td><td>J101 - 7</td><td>-15V</td></tr>
<tr><td>J102 - 1</td><td>J102 - 2</td><td>+24V</td></tr>
<tr><td>J102 - 4</td><td>J102 - 3</td><td>-24V</td></tr>
</table></td><td>YES</td><td>Replace the DC controller PCB.</td></tr>
<tr><td>DC power PCB</td><td></td><td></td><td>NO</td><td>Replace the DC power PCB.</td></tr>
</table>

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3 Illumination lamp does not light up

Cause/ Problem location	Step	Check item	Result	Countermeasure
Illumination lamp burn out	1	Is the illumination lamp (halogen lamp) burnt out?	YES	Replace the lamp.
	2	Is the control panel LED lit up?	NO	Perform the same procedure as in the DC power not supplied.
Illumination lamp setting is not complete.	3	Is the illumination lamp unit securely set?	NO	Re-set
Thermoswitch (TP1)	4	When the continuity between both terminals of the thermoswitch (TP1) is checked, is it ON?	NO	Push the thermoswitch button and check the continuity again. If it still is not ON, replace the thermoswitch.
Illumination lamp cooling fan (FM1)	5	Is the illumination lamp cooling fan (FM1) rotating?	NO	Check the wiring from the fan to the DC power supply PCB.
Wiring	6	Set the tester range to 30 VDC. Connect the tester ⊕ probe to J802-1 and connect the tester ⊖ probe to J802-2 on the DC power PCB. Turn the power ON. Confirm whether the voltage is about 15 V to 20V.	YES	Check the wiring from the DC power PCB to the illumination lamp.
DC power supply PCB	7	If the DC power supply PCB is replaced, is there an improvement?	YES	OK
DC controller PCB			NO	Replace the DC controller PCB.

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4 Scanner does not operate

Cause/ Problem location	Step	Check item	Result	Countermeasure
	1	Push the push switch (SW102) on the DC controller and enter the service mode. and set the address to "33" (check mode). If the "AE" key is pushed with the number of prints set to "01" or "02," does the scanner motor (M1) rotate?	NO	Perform step 3.
Gear mismatched bad	2	If the scanner motor (M1) is run again in the service mode, do the driving gear and arm rotate?	YES	Check on the drive system (gear matching) wire runout from the scanner motor (M1).
Scanner motor (M1)	3	If the scanner motor (M1) is replaced, is it improved?	YES	OK
DC controller			NO	Replace the DC controller.

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5 Cannot focus

Cause/ Problem location	Step	Check item	Result	Countermeasure
Lens/Lens holder setting is bad.	1	Is the lens/lens holder securely set?	NO	Re-set
Keyboard	2	Is the keyboard properly connected?	NO	Re-connect.
Film control encoder (PS992)	3	Push the push switch (SW102) on the DC controller to enter the service mode. Set the address to "31" (I/O display mode), and push the AE key. Set address at "32". When the image adjusting dial is turned, are numerals displayed in the number of sheets indicator?	NO	Set the tester range to 12 VDC: Connect the tester ⊕ probe to the keyboard PCB J603-4 and the ⊖ probe to J603-5, J603-6. If the tester reads approximately 5 V ↔ 0 V when the control dial is slowly rotated, replace the film control encoder (PS992).
Focus motor (M5)	4	Set the tester range to 30 VDC. Connect the tester probe to the connectors on the DC controller PCB shown below. When the control dials is rotated left and right, does the tester read approximately 0-20 V?	YES	Check the wiring from the DC controller PCB to the focus motor. If it is good, replace the focus motor (M5).
DC controller PCB			NO	Replace the DC controller PCB.

⊕ probe	⊖ probe
J111 - 4	J111 - 5
	J111 - 6
	J111 - 7
	J111 - 8

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6 Cannot zoom

Cause/ Problem location	Step	Check item	Result	Countermeasure
Lens/Lens holder setting is bad.	1	Is the lens/lens holder unit securely set?	NO	Re-set
Keyboard	2	Is the keyboard properly connected?	NO	Re-connect.
Film control encoder (RS992)	3	Push the push switch (SW102) on the DC controller to enter the service mode. Set the address to "31" (I/O display mode), and push the AE key. Set address at "32". When the image adjusting dial is turned, are namerals displayed in the number of sheets indicator?	NO	Set the tester range to 12 VDC. Connect the tester ⊕ probe to the keyboard PCB J103-4 and the ⊖ probe to J103-5, J103-6. If the tester reads approximately 5 V ↔ 0 V when the control dial is slowly rotated, replace the film control encoder (PS992).
Zooming motor (M3)	4	Set the tester range to 30 VDC. Connect the tester probe to the connectors of DC power PCB shown below. When the control dials is rotated left and right, does the tester read approximately 0-20 V?	YES	Check the wiring from the DC controller PCB to the zooming motor. If it is good, replace the zooming motor (M3).
DC controller PCB			NO	Replace the DC controller PCB.

⊖ probe	⊕ probe
J107 - 1	J107 - 2
	J107 - 3
	J107 - 4
	J107 - 5

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7 Cannot rotate

Cause/ Problem location	Step	Check Item	Result	Countermeasure
Lens/Lens holder setting is bad.	1	Is the lens/lens holder unit securely set?	NO	Re-set
Keyboard	2	Is the keyboard proprely connected?	NO	Re-connect.
Film control encoder (RS992)	3	Push the push switch (SW102) on the DC controller to enter the service mode. Set the address to "31" (I/O display mode), and push the AE key. Set address at "32". When the image adjusting dial is turned, are namerals displayed in the number of sheets indicator?	NO	Set the tester range to 12 VDC. Connect the tester ⊕ probe to the keyboard PCB J103-4 and the ⊖ probe to J103-5, J103-6. If the tester reads approximately 5 V ↔ 0 V when the control dial is slowly rotated, replace the film control encoder (PS992).
Rotation motor (M4)	4	Set the tester range to 30 VDC. Connect the tester probe to the connectors of DC power PCB shown below and enter the service mode (check mode). When the control dials is rotated left and right, does the tester read approximately 0-20 V?	YES	Check the wiring from the DC controller PCB to the rotation motor. If it is good, replace the rotation motor (M4).
DC controller PCB			NO	Replace the DC controller PCB.

⊕ probe	⊖ probe
J107 - 8	J107 - 6
	J107 - 7
J107 - 11	J107 - 9
	J107 - 10

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III. SELF DIAGNOSTICS

This machine has self diagnostics functions to test the machine condition (especially sensor quality) with the micro computer in the DC controller. If something is found to be abnormal during an occasional diagnostic, the machine can display an error code on the control assembly. The table below shows the display error codes, defective substances, and detection timing.

Also when the machine receives an error from the LBP, the code will flash on the print number display assembly.

Exxx: Service man call error
Pxxx: Jam display (refer to Chapter 1 for the further information).
Lxxx: User call error
Example of display: E202
E2 ↔ 02 (displayed alternatively)

A. Service man call error

Display code	Main cause	Detection timing
E000	• Wire of LBP fixing heater is broken. • Thermistor of fixing unit has improper contact and its wire is broken. • SSR is defective. • DC controller PCB is defective.	• When the [LBP fixing heater or fixing temperature control PCB is defective] signal is received from the LBP.
E010	• LBP main motor is defective. • DC controller PCB is defective.	• When the [the main motor is defective] signal is received from the LBP.
E014	• LBP fan motor is defective. • DC controller PCB is defective.	• When the [fan motor is defective] signal is received from the LBP.
E100	• LBP BD signal group is defective. • DC controller PCB is defective.	• When the [laser diode or laser scanner is defective] signal is received from the LBP.
E110	• LBP polygon motor is defective. • DC controller PCB is defective.	• When the [the main motor is defective] signal is received from the LBP.
E193	• Vertical synchronized signal error. • DC controller PCB is defective.	• When the vertical synchronized signal is not output within the specific time from the gate array on the DC controller PCB.

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Display code	Main cause	Detection timing
E202	• The scanner motor (M1) is defective. • The scanner home position detection sensor (PS 1) is defective. • The DC controller PCB is defective.	• The scanner does not reach the home position within the specific time. • The scanner home position detection sensor (PS1) is kept detected even after the specific time.
E260	• The power cooling fan (FM2) is defective. • The DC controller PCB is defective.	• When the locked power cooling fan (FM2) is detected.
E271	• The rotation motor (M4) is defective. • The prism home position detection sensor (PS5) is defective. • The DC controller PCB is defective.	• When the rotation motor (M4) is run, the prism home position detection sensor (PS5) is not reached within the specific time. • The prism home position detection sensor (PS5) is kept detected even after the specific time.
E273	• The condenser lens motor (M2) is defective. • The condenser lens home position detection sensor (PS2) are defective. • DC controller PCB is defective.	• When the condenser lens motor (M2) is run, the condenser lens home position detection sensors (PS2) are not reached within the specific time. • The condenser lens home position detection sensors (PS2) are kept detected even after the specific time. • If 24 V is detected when the condenser lens drive motor is stationary.
E275	• The zooming motor (M3) is defective. • The DC controller PCB is defective.	• If 24 V is detected when the zooming motor (M3) is stationary.
E276	• The focusing motor (M5) is defective. • The DC controller PCB is defective.	• If 24 V is detected when focusing motor (M5) is stationary.
E802	• The backup RAM error • The DC controller PCB is defective.	• If the data of backup RAM is deleted when the power is ON.

Reset method :
E000 to E110 : Errors can be cleared by turning ON/OFF the power to LBP.
E193 to E802 : Errors can be cleared by turning ON/OFF the power to MS400/MS500.

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B. User call error

Display code	Main cause	Detection timing	Reset method
L1	• LBP print paper is out	• The print paper is not supplied to the LBP.	• Set the LBP print paper.
L2	• LBP toner is out.	• The amount of LBP toner is low. • The cartridge is not set to the LBP.	• Supply the LBP toner. • Set the cartridge to the LBP.
L4	• The LBP cover is open.	• The LBP cover is open.	• Close the LBP cover.
L5	• The illumination lamp is burnt out.	• The illumination lamp does not light. • When the illumination lamp cooling fan does not rotate. • When there is something wrong with the power supply.	• Set a new illumination lamp.
L6	• The zoom lens is improper.	• The zoom lens specified by zoom memory is not set. • LBP does not detect the specified magnification is not detected within the specified time when the zoom lens is rotated by zoom memory.	• Set the specified zoom lens.
L7	• The coin box is abnormal	• Printable signal is not received from the coin box.	• Check the coin box.
L8	• LBP print paper is not uniform.	• The supplied paper is different in size from specified paper in the manual feed mode.	• Set the specified print paper to the LBP.
L9	• Other LBP errors.	• LBP is still warming up when the video interface is used. • LBP can not print for reasons other than the above errors (L1, L2, L4, and L8).	• Wait on the LBP standby. • ON/OFF the power once.

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IV. SERVICE MODE

A. Outline

The service mode of this machine consists of modes for checking DC load and the state of sensors and for making adjustments by inputting their addresses from the control panel at the bottom of the screen or from the keyboard.

B. Accessing Service Mode

There are two ways of accessing service mode, one by operating the switch on the DC controller and the other from the keyboard.

1. Accessing by Switch on DC Controller

Push the push switch SW102 on the DC controller.

2. Accessing from Keyboard

While pushing and holding the image adjustment selector key ① on the keyboad, pushing and releasing the clear/stop key ② on the main body control panel, then pushing and releasing the print start key ③ on the main body control panel.

When accessing the service mode, the LED 102 on the DC controller and the LED of AE key are flashing.

C. Exiting Service Mode

Service mode can be exited by pushing the reset key on the keyboard.

Also, set data at "00" with address "1", and push AE key.

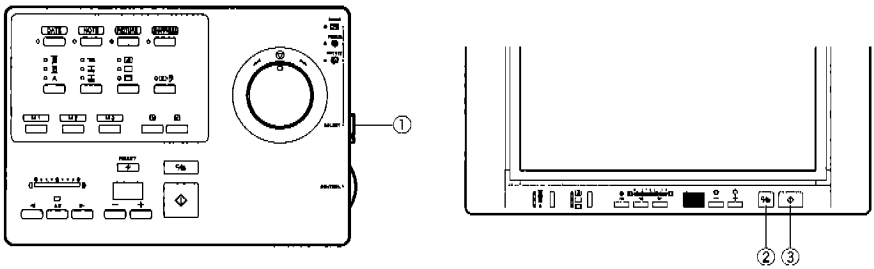

Figure 7-2

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D. Service Mode Operation

1. Operation

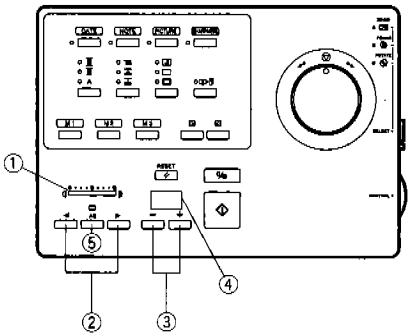


Figure 7-3

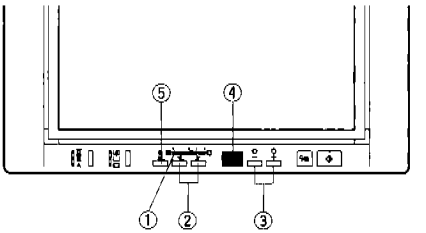


Figure 7-4

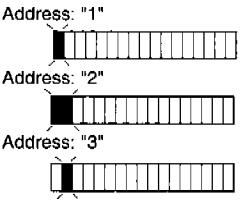
① Print density indicator
Indicates the selected address.
② Print density adjusting keys
Select address
▶ Density increases with this key
◀ Density decreases with this key
③ Print number setting key
Set data
[+] Print number increase with this key
[–] Print number decrease with this key
④ Print number indicator
Displays data
⑤ AE key
Sets the data indicated on the print number indicator.

• Select address

The address can be determined by the location at which the print density indicator light.

When the address is "1", the print density indicator on the left end lights. When the address is "2", the LED to the right of the left end lights at the same time.

When the address is "3", the LED second from the left lights. In this manner, the LED on the right side lights successively, as the address increases.



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D. Service Mode

1. Operation

Address	Name	Description
1	Service Mode Cancelling Mode	Set data at "00" and push AE key. Also, service mode can be exited by pushing the reset key on the keyboard. Sevice Mode is cancelled.
	Print Message ON/OFF Setting Mode	Set data at "01" and push AE key. Select data with clear/stop key. The following is indicated on the number of print copies indicating LEDs: If DATA ON: "d-" If NOTE ON: "-n" Ends with AE key. (MS400 only) (Default: not print)
	Date Setting Mode	Set data at "02" and push AE key. Mode becomes date setting mode. Ends with AE key. (Only MS400) (Default: refer to table 7-1)
	Note Setting Mode	Set data at "03" and push AE key. Mode becomes note setting mode. Ends with AE key. (Only MS400) (Default: all blank)
	Cassette Change Setting Mode	Set data at "04" and push AE key. Select data with negative/positive selector key. The following is indicated by the negative/positive selector LEDs: When negative is indicated→Tray is selected When positive is indicated→Upper deck is selected (Default) When auto is indicated→Lower deck is selected Ends with AE key. (MS400 only)
	Tray Setting Mode	Set data at "05" and push AE key. Mode becomes set the paper size of the tray setting. Ends with AE key. (MS400 only) (Default: ; ;)
	Area Setting Mode	Set data at "06" and push AE key. Mode becomes select on the index area designation position. Ends with AE key. (Default: ; ;)

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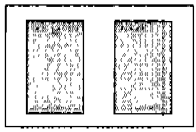
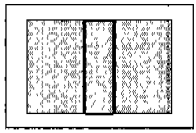
Address	Name	Description
1	Sharpness Setting Mode	Set data at "07" and push AE key. Mode becomes sharpness setting mode. Ends with AE key. (MS400 only) (Default: center)
	Prism Home Position Movement Unabled Setting Mode	Set data at "80" and push AE key. Sets prism so that it is not returned to home position when power is turned on.
	Prism Home Position Movement Enabled Setting Mode	Set data at "81" and push AE key. Sets prism so that it is returned to home position when power is turned on. (Default)
	FS Controller III Print Key Unabled Setting Mode	Set data at "82" and push AE key. Sets print key on keyboard for FS controller III so that it cannot be used.
	FS Controller III Print Key Enabled Setting Mode	Set data at "83" and push AE key. Sets print key on keyboard for FS controller III so that it can be used. (Default)
	Inner Frame Erasing Movement Enabled Setting Mode	Set data at "84" and push AE key. Sets machine so that inner frame can be erased. 
	Inner Frame Erasing Movement Unabled Setting Mode	Set data at "85" and push AE key. Sets machine so that inner frame cannot be erased.  (Default)
	Coin Box Use Enabled Setting Mode	Set data at "86" and push AE key. Sets coin box so that it can be used.
	Coin Box Use Unabled Setting Mode	Set data at "87" and push AE key. Sets coin box so that it cannot be used. (Default)
	Mode for Setting Framing of Frame Erasure Mode 2 at 4mm	Set data at "88" and push AE key. Sets framing of frame erasure mode 2 as 4mm border.

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Address	Name	Description
1	Mode for Setting Framing of Frame Erasure Mode 2 at 8mm	Set data at "89" and push AE key. Sets framing of frame erasure mode 2 as 8mm border. (Default)
	Default Key Clearing Mode	Set data at "00" and push AE key. Returns print mode to factory default value when power is turned on.
	Total number of Scans Clearing Mode	Set data at "C 1" and push AE key. Value of total number of scans returns to 0.
	RAM Clearing Mode	Set data at "CF" and push AE key. Power on reset is automatically activated after RAM data is reset.
	Scanner Service Position Mode	Set data at "F0" and push AE key. Cam moves to position which allows scanner motor unit to be removed.
	Condenser Lens Home Position Moving Mode	Set data at "F 1" and push AE key. The condenser lens will move to home positon. (MS500 only)
	Service Data Printing Mode	Set data at "F2" and push AE key. Prints model name, ROM version, total number of scans, and histogram of image density. (Refer to print sample : Fig. 7-6).
	ASCII Code Printing Mode	Set data at "F3" and push AE key. Prints ASCII code table. (Refer to print sample : Fig. 7-5).
2	Add-on Printing Data Setting Mode	Set data and push AE key. "00": Does not print service data. (Default) "01": Prints histogram of density (gain: x1) "02": Prints histogram of density (gain: x5) "03": Prints ASCII Code table (refer to print sample 1). "04": Prints model name, ROM version, total number of scans, and histogram of image density (refer to print sample 2)

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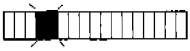
Address	Name	Description
3	Reader Position Adjusting Mode	Set data and push AE key. "00" to "7F": Reader position moves in + direction. "FF" to "80": Reader position moves in – direction. (Increase/decrease of 1 moves position 1mm). Normally, do not operate. (Default: refer to Fig. 7-7)
4	Vartical scanning Direction Registration Adjusting Mode	Set data and push AE key. "00" to "7F": Image moves upward "FF" to "80": Image moves downward (Increase/decrease of 1 moves position 1mm). (Default: refer to Fig. 7-7)
5	Horizontal Scanning Direction Registration Adjusting Mode	Set data and push AE key. "00" to "7F": Image moves to right "FF" to "80": Image moves to left (Increase/decrease of 1 moves position 1mm). (Default: refer to Fig. 7-7)
6	Area Setting Y Position Correcting Mode	Set data and push AE key. "00" to "7F": Moves area setting position to downward "FF" to "80": Moves area setting position to upward (Corrected by 1 mm for each increase or decrease of 1.) (Default: refer to Fig. 7-7)
7	Area Setting X Position Correcting Mode	Set data and push AE key. "00" to "7F": Moves area setting position to right "FF" to "80": Moves area setting position to left (Corrected by 1 mm for each increase or decrease of 1.) (Default: refer to Fig. 7-7)
8 	Automatic Border Erasing Y Direction Position Correcting Mode	Set data and push AE key. "00" to "7F": Moves position of automatic border erasing to the outside. (4mm pitch) "FF" to "80": Moves position of automatic border erasing to the inside (4mm pitch) (Default: refer to Fig. 7-7)
9	Automatic Border Erasing X Direction Position Correcting Mode	Set data and push AE key. "00" to "7F": Moves position of automatic border erasing to the outside. (4mm pitch) "FF" to "80": Moves position of automatic border erasing to the inside (4mm pitch) (Default: refer to Fig. 7-7)

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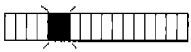
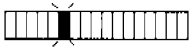
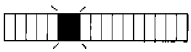
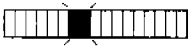
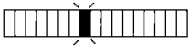
Address	Name	Description
10 	AE Density Correcting Mode	Set data and push AE key. "01" to "0F":Makes print density decided by AE darker. "FF" to "80":Makes print density decided by AE lighter. (Default: refer to Fig. 7-7)
11 	For Factory Adjustments	Not be operated in the field. (Default: refer to Fig. 7-7)
12 	For Factory Adjustments	Not to be operated in the field. (Default: refer to Fig. 7-7)
13	Mode for Adjusting Backlash of Rotation Motor (M4)	Set data and push AE key. "00" to"FF": Inputs number of pulses of backlash. (As numerical value increases, backlash becomes bigger). (Default: refer to Fig. 7-7)
14 	Mode for Adjusting Backlash of Focusing Motor (M5)	Set data and push AE key. "00" to"FF": Inputs number of pulses of backlash. (As numerical value increases, backlash becomes bigger). (Default: refer to Fig. 7-7)
15 	Mode for Adjusting Backlash of Zooming Motor (M3)	Set data and push AE key. "00" to"FF": Inputs number of pulses of backlash. (As numerical value increases, backlash becomes bigger). (Default: refer to Fig. 7-7)
16	Mode for Setting Scan Paper Size When Mounting Video Interface Board	Set data and push AE key. When video interface board has been mounted, sets paper size when scanning. "01": A4 "09": B5 "04": LTR (Default) "0C": LGL
17	Connected LBP Setting Mode	Set data and push AE key. "02": FP300

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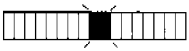
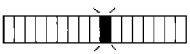
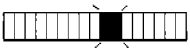
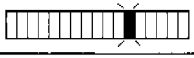
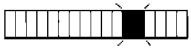
Address	Name	Description
18 	Illumination Lamp Auto Off Setting Mode	Set the data and push the AE key. After the lapse of the set time, the illumination lamp will auto off (go out) "00": Does not auto off (Default) "01": 10 minutes "02": 20 minutes "03": 30 minutes "05": 60 minutes "0C": 120 minutes
19 	Mode for Setting Data of Reader Light Intensity (Low Magnification Ratio)	Set data and push AE key. "00" to"FF": Inputs reader light intensity (analog value). When numerical value is increased, light intensity goes up. (Low magnification ratio: x7 to x32) (Default: "FF")
20 	Mode for Setting Data of Reader Light Intensity (High Magnification Ratio)	Set data and push AE key. "00" to"dc": Inputs reader light intensity (analog value). When numerical value is increased, light intensity goes up. (High magnification ratio: x32 to 55) (Default: "dc")
21	For Factory Adjustments	Not to be operated in the field. (Default: "80")
22	Unused	(Default: "80")
23 	Unused	(Default: "80")
24 	Designated Area Position (X0)Indicating Mode	Position is indicated on the number of print copies indicating LED. The left end is 0 and indication is in 2mm intervals. (X0: Left side knob of X direction)
25	Designated Area Position (X1)Indicating Mode	Position is indicated on the number of print copies indicating LED. The left end is 0 and indication is in 2mm intervals. (X1: Right side knob of X direction)

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Address	Name	Description
26	Designated Area Position (Y0)Indicating Mode	Position is indicated on the number of print copies indicating LED. The bottom is 0 and indication is in 2mm intervals. (Y0: Top knob of Y direction)
27	Designated Area Position (Y1)Indicating Mode	Position is indicated on the number of print copies indicating LED. The bottom is 0 and indication is in 2mm intervals. (Y1: Bottom knob of X direction)
28	Zoom Lens Magnification Ratio Indicating Mode	When zoom lens is set and the magnification ratio is changed, the position is indicated on the number of print copies indicating LEDs as follows: "00" to "0F": x20 to x48 "10" to "1F": x30 to x55 "20" to "2F": x16 to x32 "30" to "3F": x9.5 to x16 "51": x7.5 or not inserted. In case of MS400, "51" is indicated.
29	Light Intensity Adjustment dial Position Indicating Mode	Position of Light Intensity Adjustment dial is indicated on the number of print copies indicating LEDs. (MS400 only)
30	Unused	

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Address	Name	
31	I/O Indicating Address Setting Mode	**Description** Input the address whose input status is desired to be indicated on the number of print copies indicating LEDs and push AE key. Set address at "32" when indicating status. "00": Zooming reproduction ratio "01": Zooming motor (M3) applied voltage "02" Focusing motor (M5) applied voltage "03": Rotation motor (M3) applied voltage "04": Scanner motor (M1) applied voltage "05": Condenser lens motor (M2) applied voltage "06": Unused "07": Unused "08": (Area designation Y3: Y direction lower side) "09": (Area designation Y2: Y direction lower side) "0A": (Area designation Y0: Y direction upper side) "0b": (Area designation Y1: Y direction upper side) "0C": (Area designation X1: X direction left side) "0d": (Area designation X0: X direction left side) "0E": (Area designation X2: X direction right side) "0F": (Area designation X3: X direction right side) "10": Zoom lens reproduction ratio position "11": Zoom lens reproduction ratio pulse position
32	Check Indicating Mode	When AE key is pushed, the item set with the I/O indicating mode (address "31") is executed. Status of input is indicated on the number of print

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Address	Name	copies indicating LEDs.
33	DC Load Checking Mode	**Description** The item indicated on the number of print copies indicating LEDs can be checked. DC load is activated while AE key is pushed. "00": All LEDs flashing "01": Scanner motor (M1) forward rotation "02": Scanner motor (M1) reverse rotation "03": Rotation motor (M4) forward rotation "04": Rotation motor (M4) reverse rotation "05": Focusing motor (M5) forward rotation "06": Focusing motor (M5) reverse rotation "07": Zooming motor (M3) forward rotation "08": Zooming motor (M3) reverse rotation "09": Condenser lens drive motor (M2) forward rotation "0A": Condenser lens drive motor (M2) reverse rotation

Default of Date Setting Mode (Address "1", Data "02")

Machine model etc.	Date Format	Printing Position	Set time
100 V	"00" (Year/month/day)	Upper right	Japan standard
120 V	"02" (Month/day/year)	Upper right	Japan standard
220-240 V	"04"(Day/month/year)	Upper right	Japan standard
When RAM reset	"01"(Year/month/day Hour: min)	Upper right	Japan standard

Table 7-1

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ASCII CODE TABLE

	2X	3X	4X	5X	6X	7X
x0	sp	0	@	P	`	p
x1	!	1	A	Q	a	q
x2	"	2	B	R	b	r
x3	#	3	C	S	c	s
x4	$	4	D	T	d	t
x5	%	5	E	U	e	u
x6	&	6	F	V	f	v
x7	'	7	G	W	g	w
x8	(	8	H	X	h	x
x9	)	9	I	Y	i	y
xA	*	:	J	Z	j	z
xB	+	;	K	[	k	{
xC	,	<	L	\	l	|
xD	-	=	M	]	m	}
xE	.	>	N	^	n	~
xF	/	?	O	_	o	⌂

Figure 7-5

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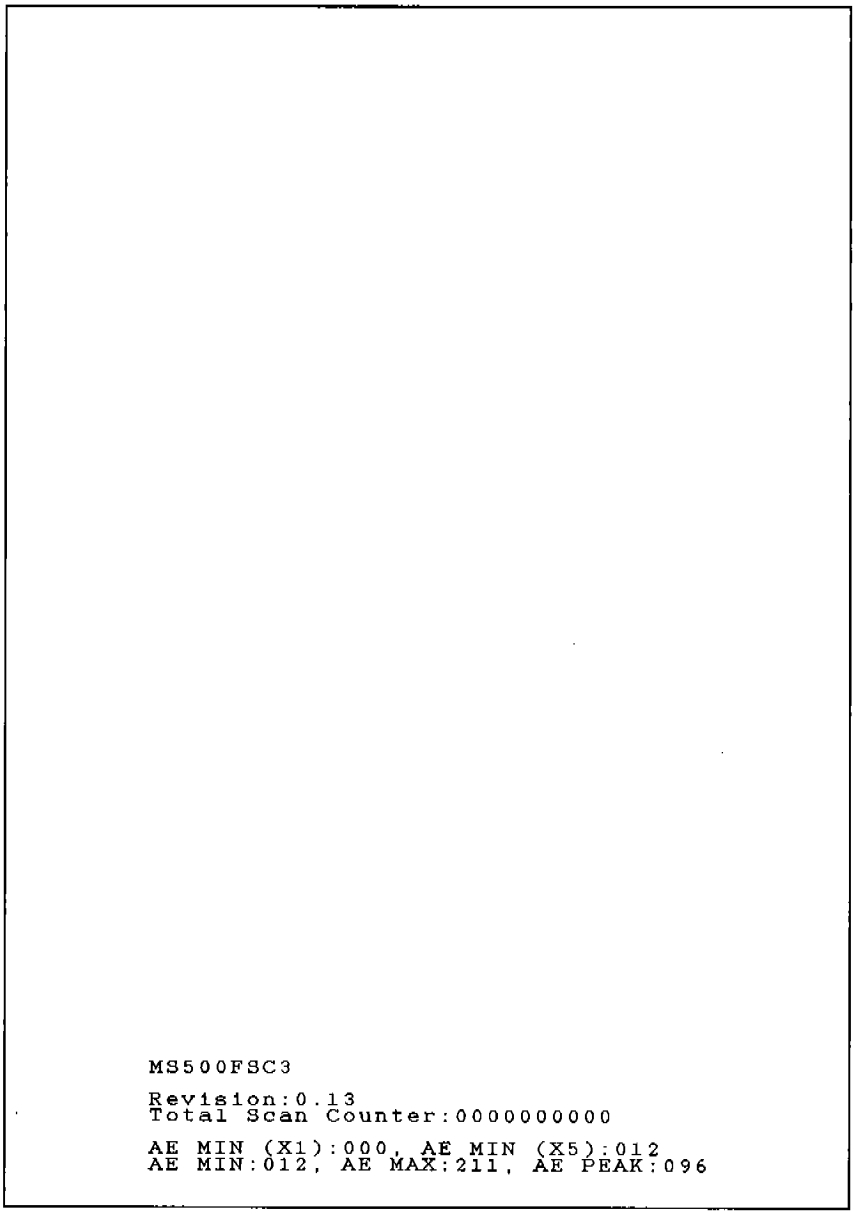

Figure 7-6

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V. PROCEDURE FOR REPLACING ELECTRICAL COMPONENTS

Outline

Some electrical components incorporated in this machine do not function well just by replacing them, and require some adjusting and mode setting.

The following are the components that require adjusting, mode setting, etc. after replacement.

- BASIS unit
- DC controller PCB

Note: When replacing electrical components, always turn the power off.

A. Replacing BASIS Unit

After replacing the BASIS unit, change the ROM inserted in the BASIS unit PCB with IC102 on the DC controller PCB.

1) Point to observe when replacing
   Pay attention to direction and position in which P-ROM is inserted.
   Althrough adjustments, etc. are not necessary after replacement, check that machine prints properly.
2) Action after replacing
   ① Initializing of RAM
   a. Place the dip switches on the DC controller PCB on the previous settings.
   b. Place in service mode.
   c. Set address at "1" and data at "ごF" and push [AE] key.
      (Return RAM contents to default).
   d. Set parameters in service mode to the factory data [Factory Default] entered on the service mode label.
   e. Set all the parameters to those that were noted before replacing.
   f. Check that machine prints properly.

B. Replacing DC Controller PCB

1) Action before replacing
   Make a note of all the parameters in service mode.
2) Action after replacing
   ① Initializing of RAM
   a. Place the dip switches on the DC controller PCB on the previous settings.
   b. Place in service mode.
   c. Set address at "1" and data at "ごF" and push [AE] key.
      (Return RAM contents to default).
   d. Set parameters in service mode to the factory data [Factory Default] entered on the service mode label.
   e. Set all the parameters to those that were noted before replacing.
   f. Check that machine prints properly.

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Description	Address	Default	Factory Default
READER_POS	No. 3	00	
REG	No. 4	00	
SIDE_REG	No. 5	00	
AREA_Y	No. 6	00	
AREA_X	No. 7	00	
BE_Y	No. 8	00	
BE_X	No. 9	00	
AE_ADJ	No. 10	00	
AREA_AD_ADJ	No. 11	00	
ZOOM_AD_ADJ	No. 12	00	
PRISM_BAC	No. 13	03	
FOCUS_BAC	No. 14	52	
ZOOM_BAC	No. 15	1A	

Figure 7-7 (Service Mode Label)

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I. LIST OF SIGNALS AND COMMANDS

The list below shows code addresses and meanings of signal names used in this manual and circuit diagrams.

Signal Name

CKNOB A	Control KNOB signal A
CKNOB B	Control KNOB signal A
CKNOB C	Control KNOB center signal
CL 0	Condenser Lens drive command 0
CL 1	Condenser Lens drive command 1
CL 2	Condenser Lens drive command 2
CL 3	Condenser Lens drive command 3
CL STB	Condenser Lens STandBy signal
CL1 HP	Condenser Lens 1 Home Position signal
CL2 HP	Condenser Lens 2 Home Position signal
CL3HP	Condenser Lens 3 Home Position signal
CLK	CLocK signal
COM A	scanner Motor drive COMmon signal A
COM B	scanner Motor drive COMmon signal B
COM RA	Rotation motor COMmon signal A
COM RB	Rotation motor COMmon signal B
DGT 0	key switch DiGiT signal 0
DGT 1	key switch DiGiT signal 1
DGT 2	key switch DiGiT signal 2
DGT 3	key switch DiGiT signal 3
DGT 4	key switch DiGiT signal 4
FCS 0	FoCuS motor drive command 0
FCS 1	FoCuS motor drive command 1
FCS 2	FoCuS motor drive command 2
FCS 3	FoCuS motor drive command 3
FCS COM	FoCuS motor COMmon signal
FM1 LOK	Fan Motor 1 LOcK signal
FM2 LOK	Fan Motor 2 lOck signal
H/L SPEED	motor High/Low SPEED select signal
K SEG 0	Key switch SEGment signal 0
K SEG 1	Key switch SEGment signal 1
KDEG	Key led DiGit signal
KLED SEG 10	Key LED SEGment signal 10
KLED SEG 11	Key LED SEGment signal 11
KLED SEG 9	Key LED SEGment signal 9
LAMP P	illumination LAMP Power on signal
LED SEG 0	LED display SEGment signal 0
LED SEG 1	LED display SEGment signal 1
LED SEG 2	LED display SEGment signal 2
LED SEG 3	LED display SEGment signal 3
LED SEG 4	LED display SEGment signal 4
LED SEG 5	LED display SEGment signal 5
LED SEG 6	LED display SEGment signal 6
LED SEG 7	LED display SEGment signal 7
LEFT MOTOR	LEFT MOTOR drive command
MA	scanner Motor drove signal A
MB	scanner Motor drove signal B
MOTOR SPEED	MOTOR SPEED control signal
RA	Rotation motor drive command A
RB	Rotation motor drive command B
RIGHT MOTOR	MOTOR SPEED control signal
ROT HP	ROTation Home Position signal
SC HP	SCanner Home Position signal
SELECT SW	lens control SELECT SWitch signal
XCOM	area X COMmon signal
XA	area X signal A
XB	area X signal B
Y COM	area Y COMmon signal
YA	area Y signal A
YB	area Y signal B
ZM0	Zoom Motor drive command 1
ZM1	Zoom Motor drive command 2
ZM2	Zoom Motor drive command 3
ZM3	Zoom Motor drive command 4
ZM P+	Zoom Position +signal
ZM P-	Zoom Position -signal
ZM STB	Zoom Motor STandBy

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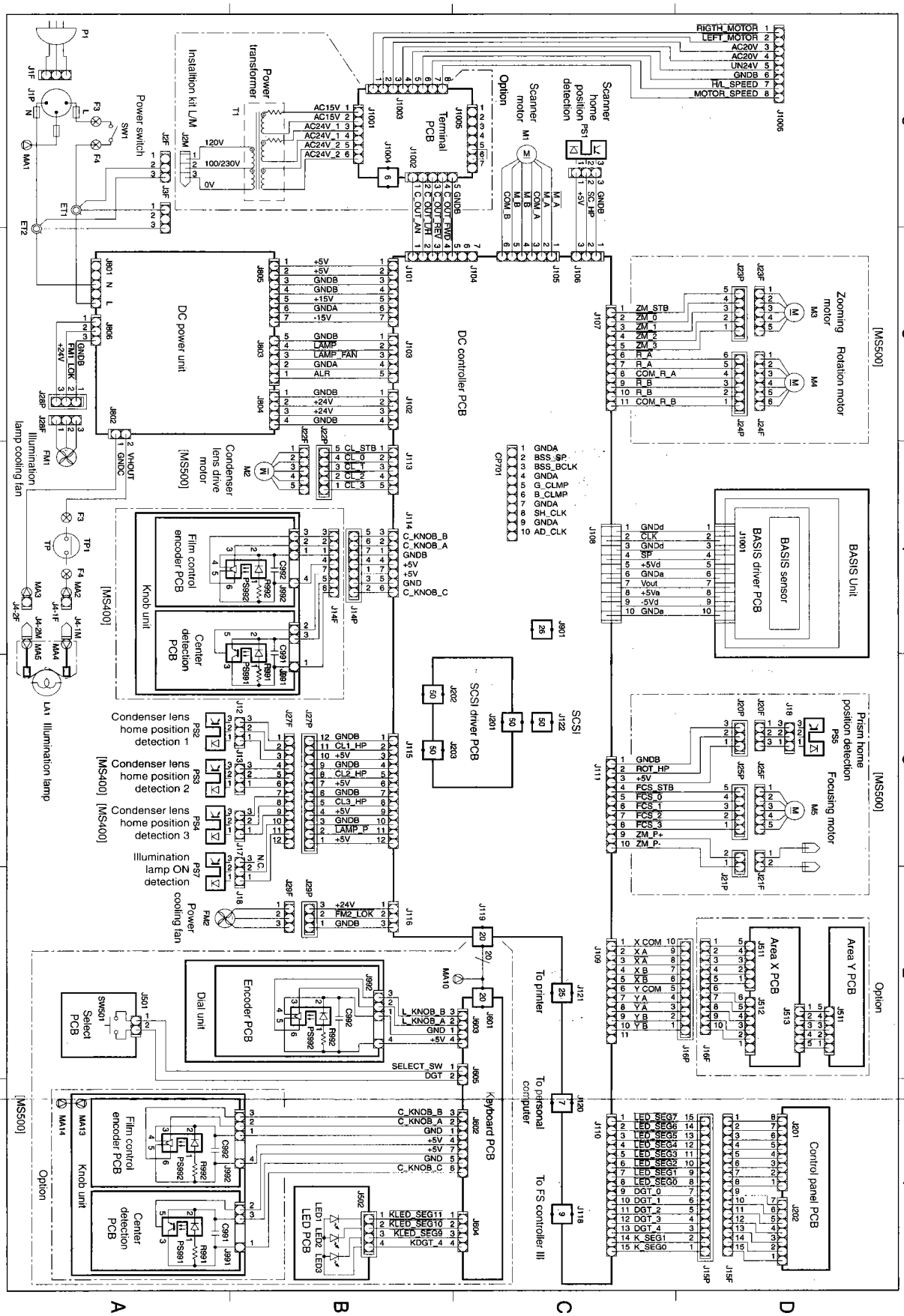
II GENERAL CIRCUIT DIAGRAM

GENERAL CIRCUIT DAIGRAM



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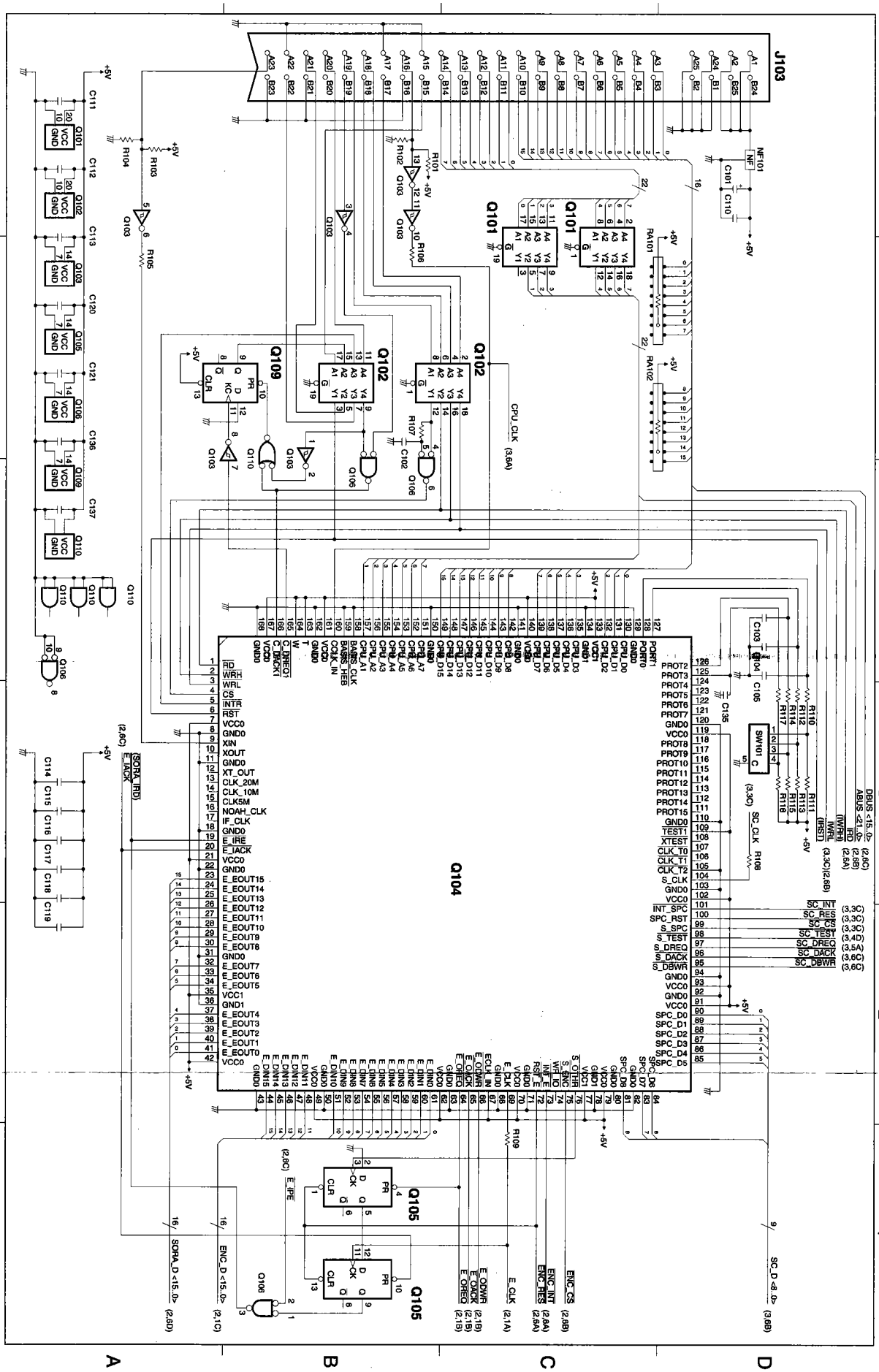
III SCSI DRIVER CIRCUIT DIAGRAM

SCSI DRIVER CIRCUIT DIAGRAM (1/3)



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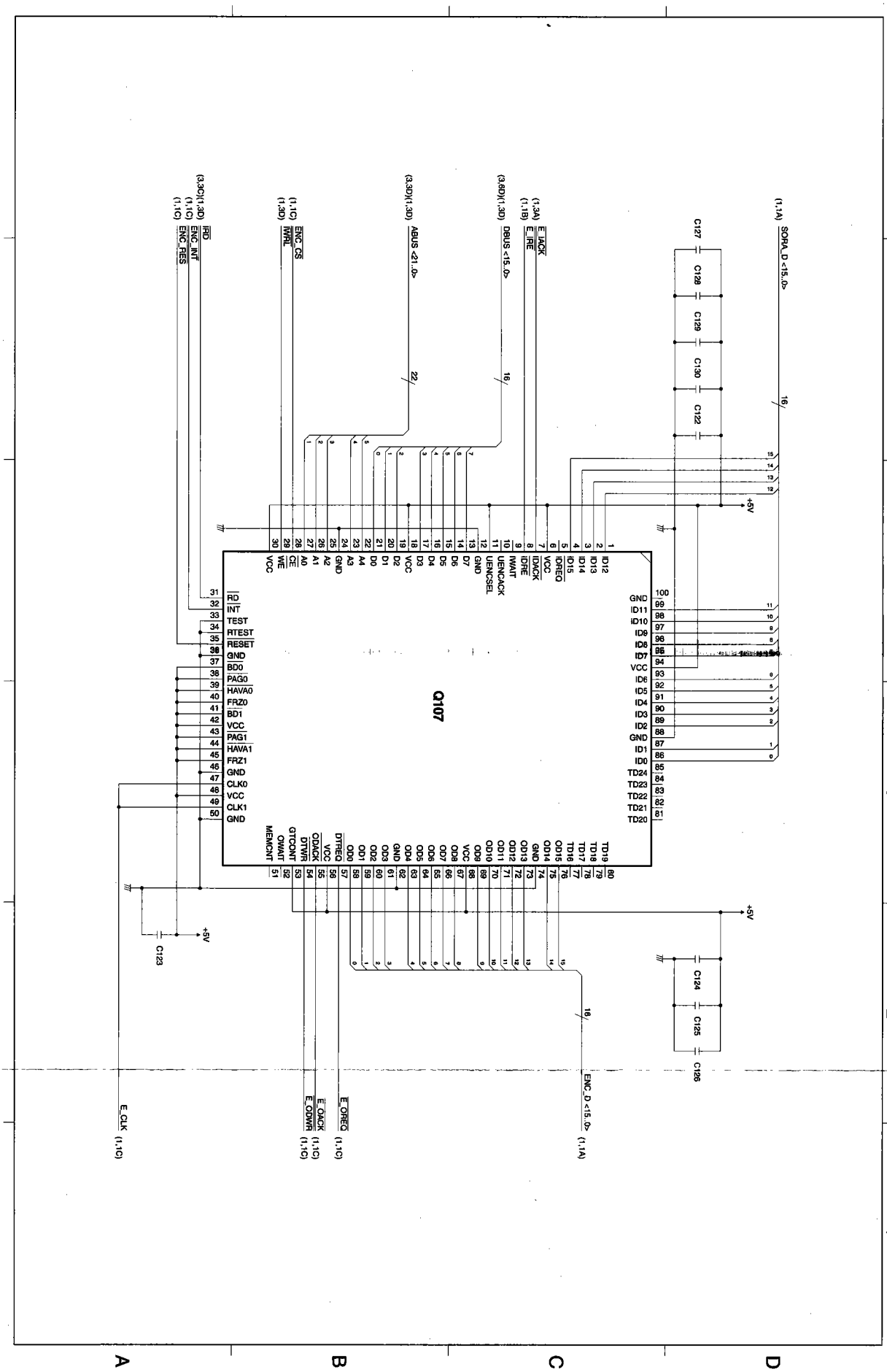

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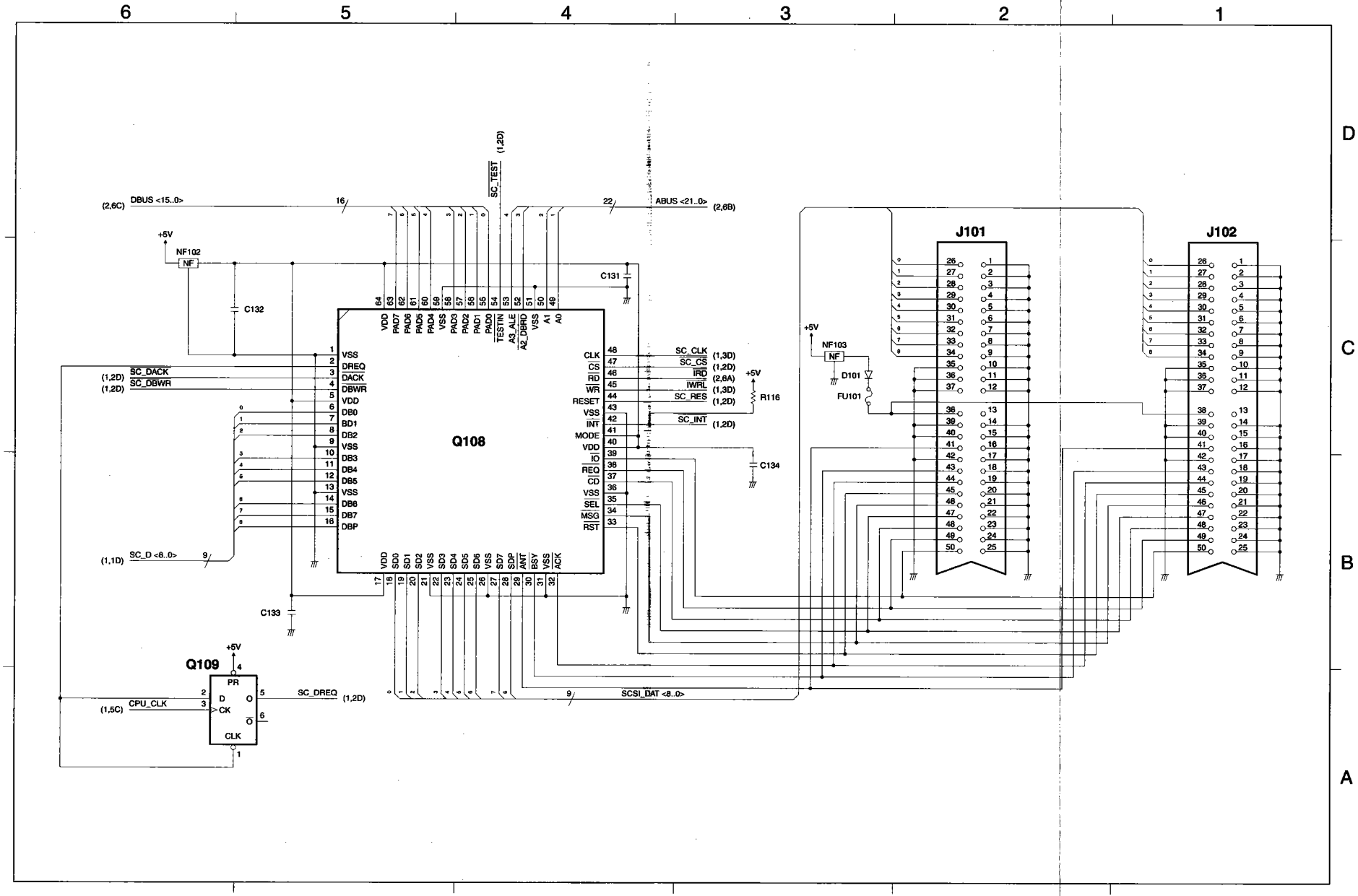
SCSI DRIVER CIRCUIT DIAGRAM (3/3)



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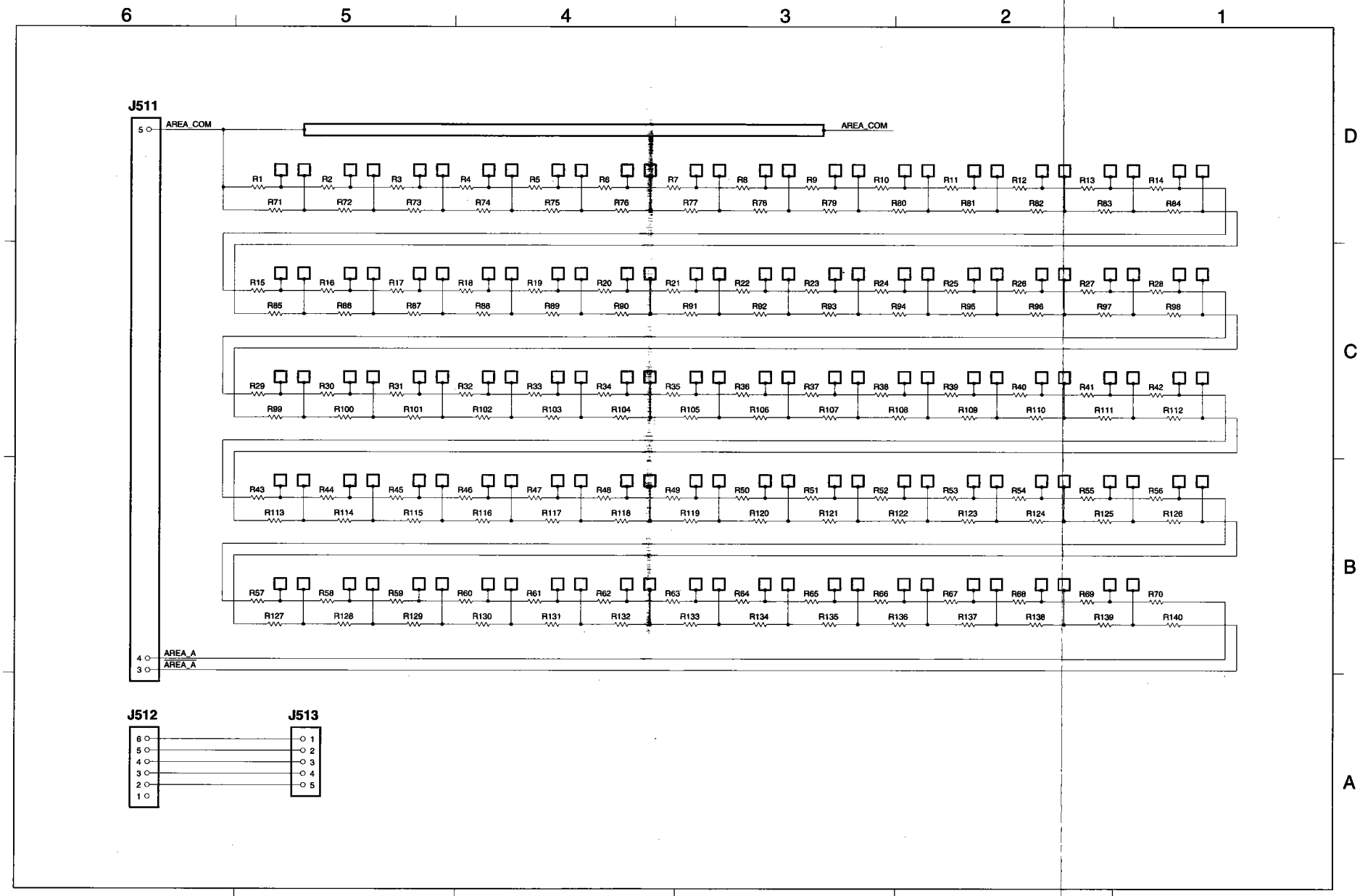
IV AREA X/AREA Y CIRCUIT DIAGRAM

AREA X / AREA Y CIRCUIT DAIGRAM (1/2)



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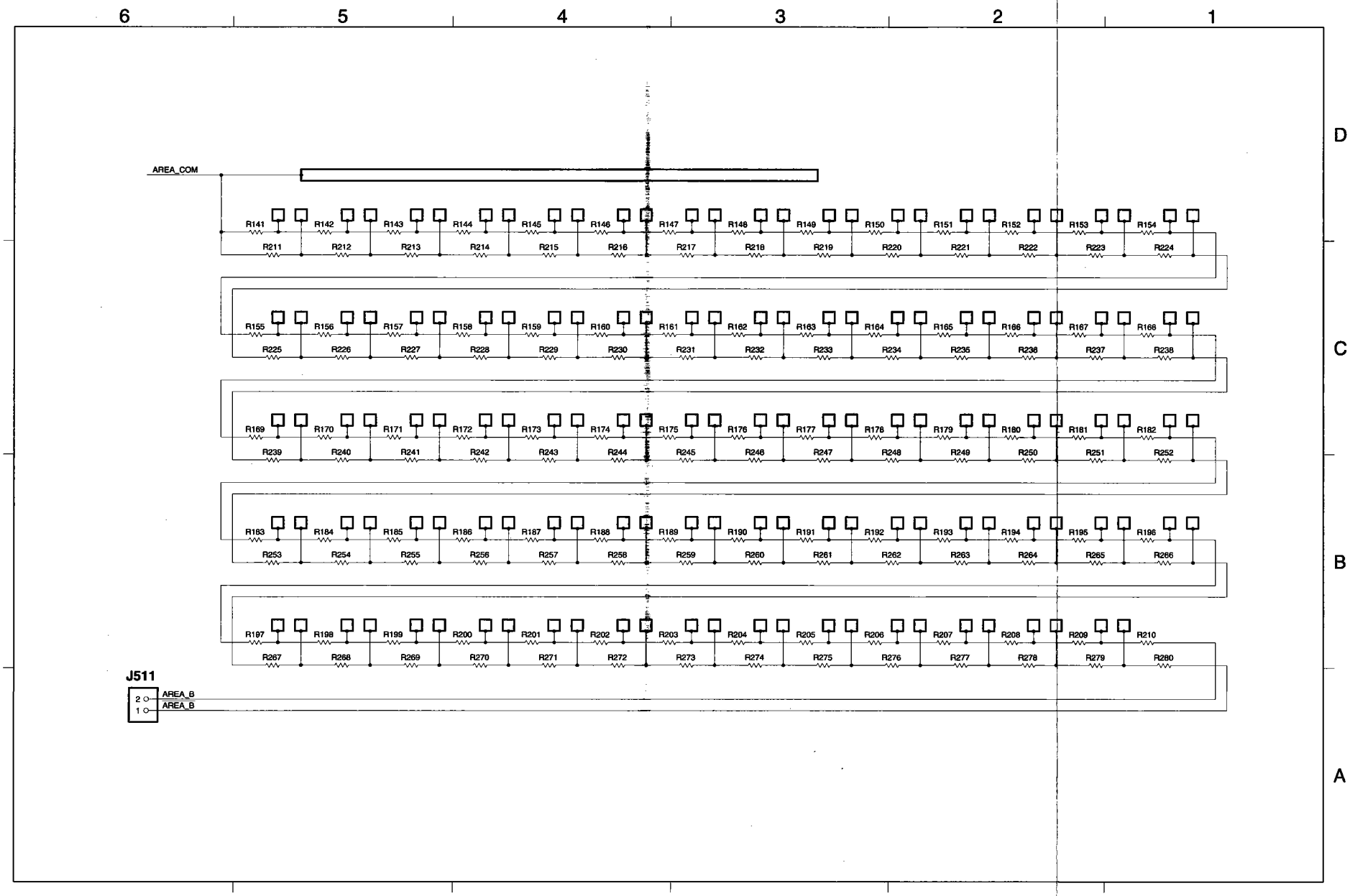

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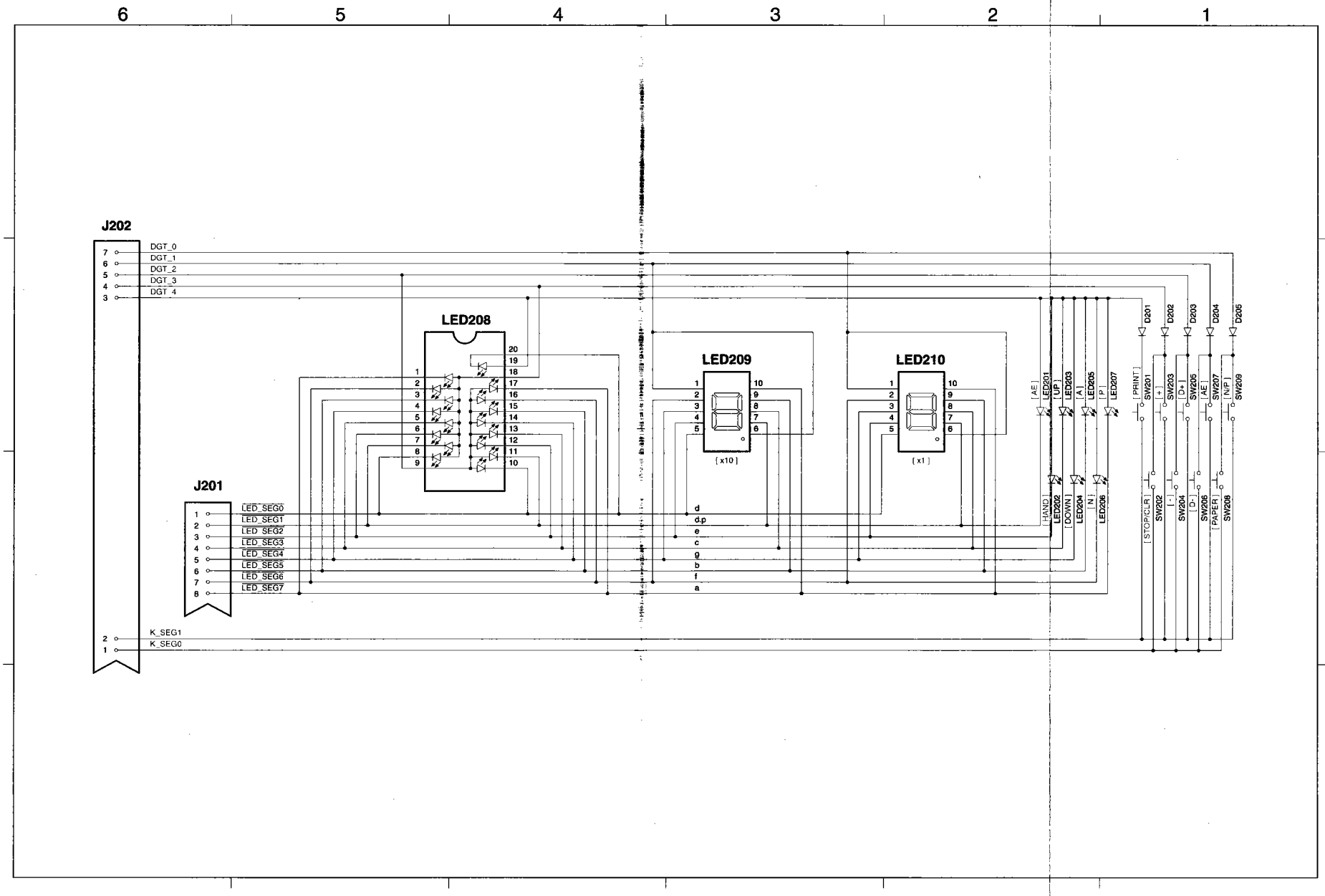
V CONTROL PANEL CIRCUIT DIAGRAM

DISPLAY CIRCUIT DAIGRAM



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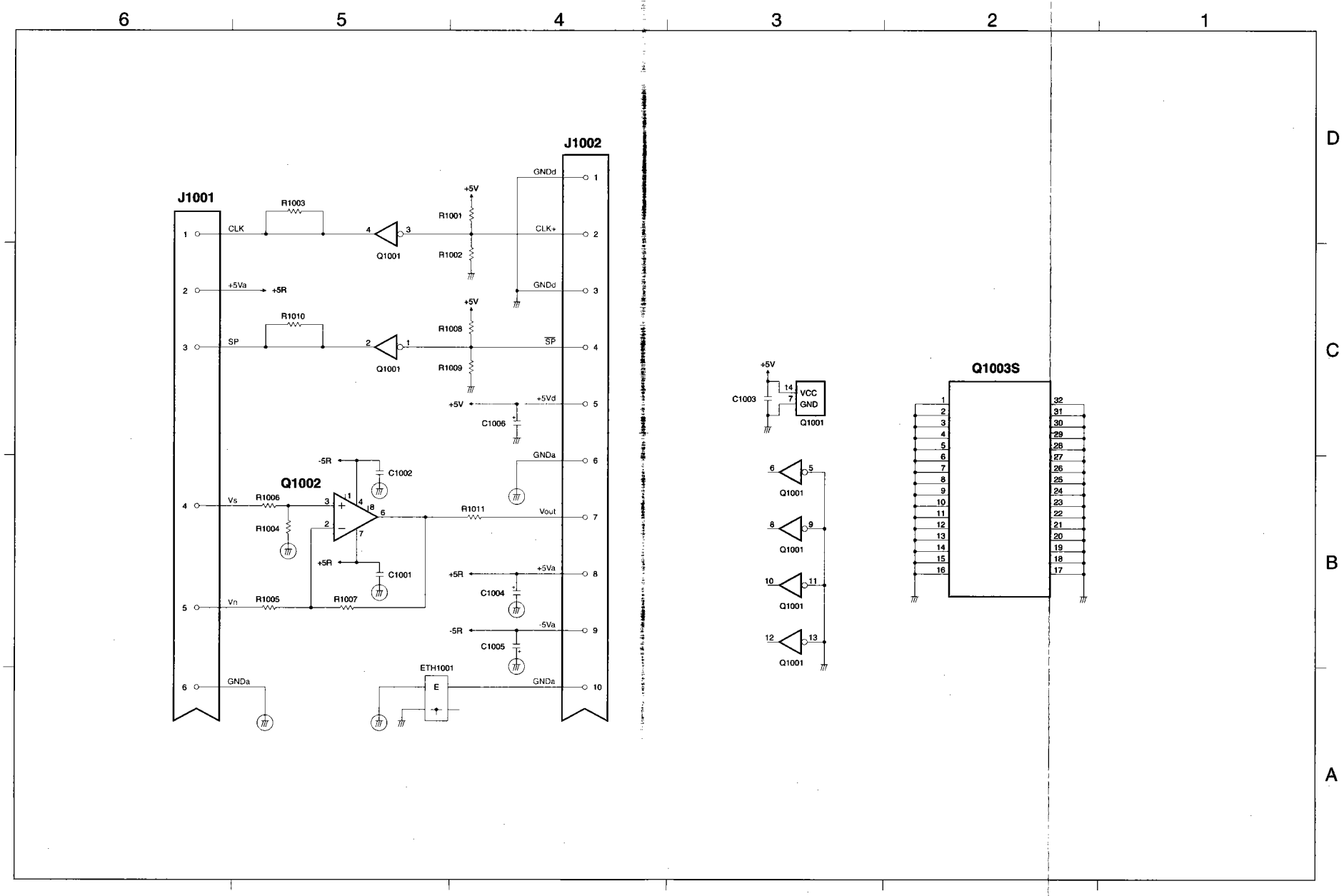
VI BASIS DRIVER CIRCUIT DIAGRAM

BASIS DRIVER CIRCUIT DAIGRAM



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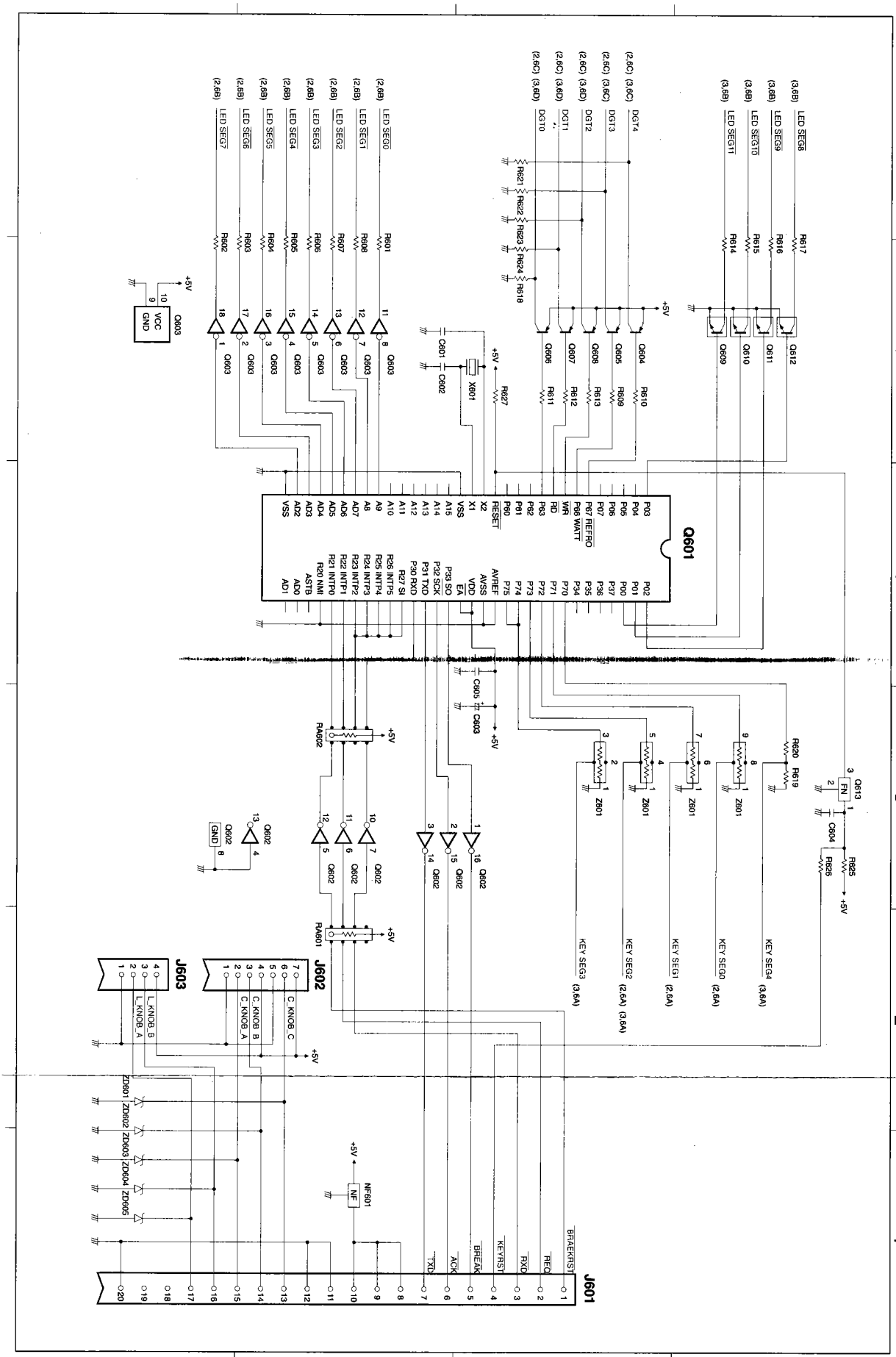
VII KEYBOARD CIRCUIT DIAGRAM

KEYBORAD CIRCUIT DAIGRAM (1/3)



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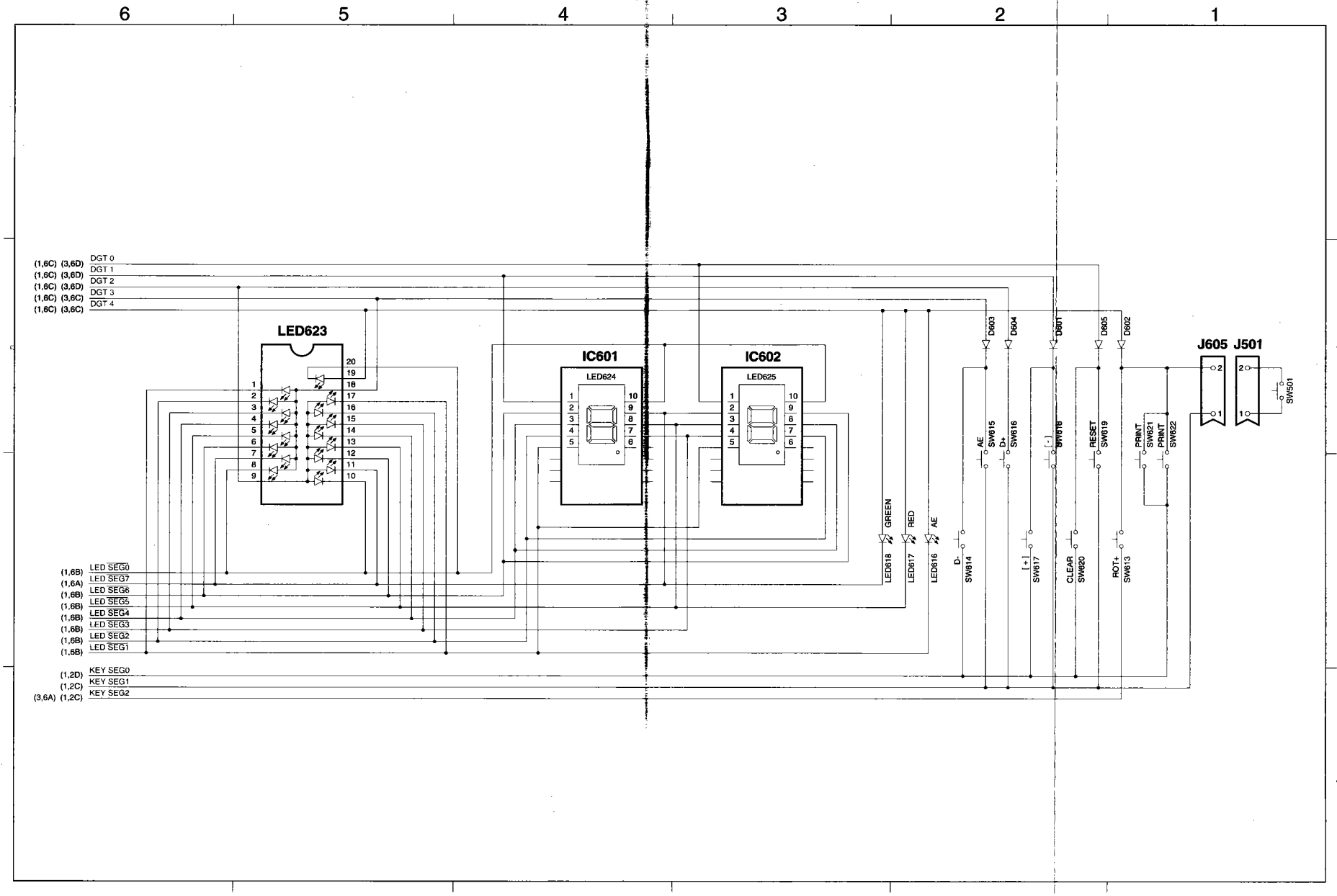
KEYBORAD CIRCUIT DAIGRAM (2/3)



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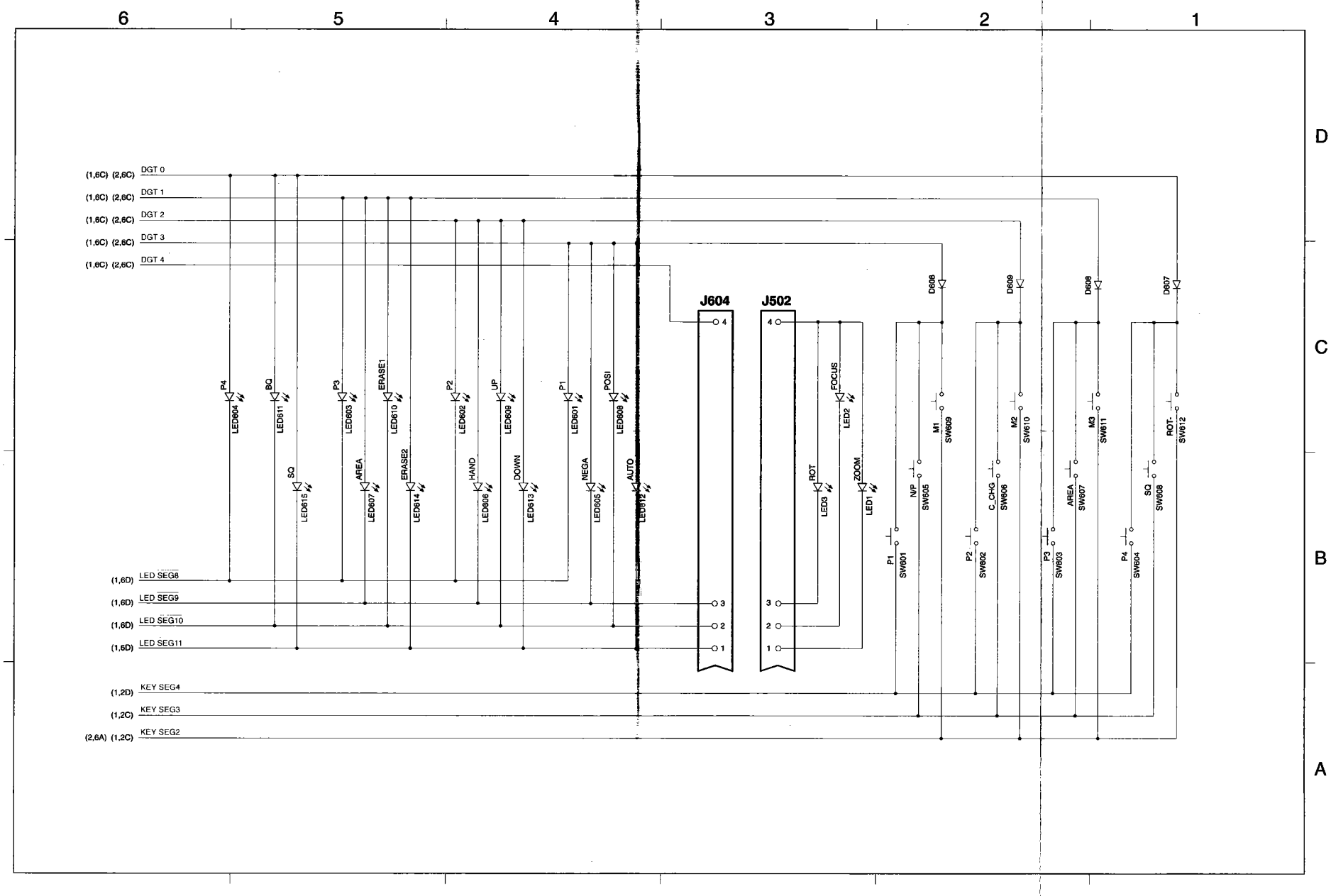
KEYBORAD CIRCUIT DAIGRAM (3/3)



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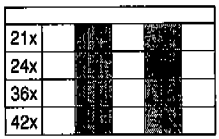
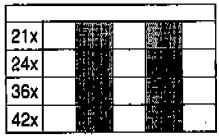
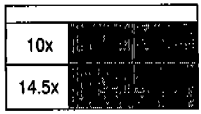
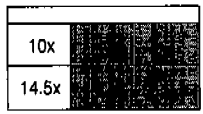
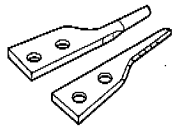
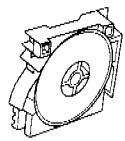
VIII. LIST OF SPECIAL TOOLS

Special tools which are required for servicing this machine in addition to the standard tool set are listed below.

No.	Tool name	Tool No.	Shape	Rank (*)	Remarks
1	Test film	TKM-0260		A	16 mm negative For each magnification 2 frames.
2	Test film	TKM-0261		A	16 mm positive For each magnification 2 frames.
3	Test film	TKM-0262		A	35 mm negative For each magnification 2 frames.
4	Test film	TKM-0263		A	35 mm positive For each magnification 2 frames.
5	Replaceable blades for pliers	CK-0426		B	For removing grip rings 4 to 9 mm.
6	Test film (code 23)	TKM-0071		B	For film scanning

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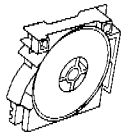
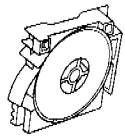
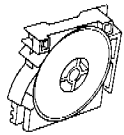
No.	Tool name	Tool No.	Shape	Rank (*)	Remarks
7	Test film (code 22)	TKM-0072		B	For film scanning
8	Test film (code 21)	TKM-0073		B	For film scanning
9	Test film (Duo 3 blip)	TKM-0268		B	For film scanning

(*) Rank
A: Each service technician should carry one with him.
B: A group of five service technicians should share one.
C: Each workshop should keep one.

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IX. SOLVENT/OIL TABLE

No.	Name	Application	Composition	Remarks
1	Ethylalcohol (Ethanol) Isopropyl alcohol (Isopropanol) C-17	Cleaning: Ex.) Glass, plastic, rubber, external covers	$C_2H_{60}H$ $(CH_3)_2$ CHOH	• Do not bring near fire • Procure locally • Substitutes: C1, IPA, (isopropyl alcohol)
2	MEK # 160	Cleaning: Ex.) Metal portions, oil smudges	Mineral oil-based hydrocarbons, chlorine-based hydrocarbons, alcohols	• Do not bring near fire • Procure locally • Substitutes: MEK
3	Heat resistant grease	Drive portion	Mineral oil-based lithium soap Molybdenum disulfide	• Vitasol MO-138S (manufactured by Hitachi Powdered Mill) • Tool No. CK-0427 (500 g/can)
4	Lubricating oil		Mineral oil (paraffin-based)	• Uniway 68 (CK-0451) • Substitutes • Suwaway S68 (manufactured by Maruzen Sekiyu) Mobil Vactra Oil No.2 (manufactured by Mobil Oil)
5	Lubricating oil		Mineral oil (paraffin-based)	• Uniway 220 (manufactured by Japan Sekiyu) • Tool No.CK-0524 (100 cc) • Substitutes: Suwaway S180 (manufactured by Maruzen Sekiyu)

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